TECHNICAL SHEETS

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FOR THE SUSTAINABLE MANAGEMENT OF TROPICAL FORESTS

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A FEW CLARIFICATIONS ARE IN ORDER!

TIMBER TREATMENTS

WHY TREAT TIMBER?

The purpose of treating timber is to improve its durability[1] when it is insufficient for a particular use; this is referred to as **preventive** treatment. This is not essential if the expected service life is low (e.g. a poplar stake for tomato plants).

It can also be carried out in order to get rid of degradation agents that the timber may contain; this is referred to as **curative** treatment.

The performance of the processes depends on the timber's impregnability[2], the technique that is used, the equipment and possibly even the product that is used. There are different types of treatment: chemical, thermal or a combination of the two.

BIOCIDAL CHEMICAL TREATMENTS

In general, the formulation of a chemical product is created with: biocidal active ingredients[3], molecules that will allow these active ingredients to be fixed onto the wood the timber, and a solvent (petroleum or water) which allows the product to be absorbed by the timber before evaporating. The active ingredients can be mineral substances (metal salts) or synthetic substances of varying degrees of complexity. Several molecules have been developed using molecules that are naturally present in timber: tannins, acids, terpenes, phenolic compounds, etc.

But the great difficulty lies in how we get them to penetrate into the timber and bond with it. This task is much easier with trees, which do it gradually throughout their life as they grow.

Very often, active ingredients target timber degradation agents: lignivorous fungi[4], Lignicolous fungi[5], xylophagous insects[6], termites, etc. Treatment products can combine several active ingredients and thus cover a wide spectrum of action.

1. The timber's resistance to biological degradation agents
2. The timber's ability to absorb liquid
3. Literally means «life-killing»
4. Feeds on timber
5. Lives in timber
6. Which eat timber

The product is applied using different techniques:

- Brushing (brush)
- Spraying (nozzle)
- Soaking (tank)
- Vacuum/pressure (autoclave[7])

⚠ «Treatment at the core» is rather misleading, because in most cases the treatment product doesn't make its way throughout the entire volume of the timber, but rather in the periphery over a variable depth. Even if this type of material allows for more effective application, the durability of the treated timber depends on, among other things its impregnability, the initial humidity of the timber, the chemical used, the pressures applied and the duration of the cycles. It is common to see the term «autoclaved timber» used by professionals as a miracle solution for marketing purposes - this term refers to an application process, not to the performance conferred upon the timber.

Another difficulty is that, due to standard requirements, the performance of treated timber is displayed by professionals via a usage class. Example: a «class 4 treated» timber is a timber with conferred durability adapted for usage class 4 (with a guarantee that varies between 3 and 5 years only). This misnomer creates confusion among users (see the durability sheet).

🔍 These same standards require that the person treating the timber must be able to provide a **treatment certificate**. This certificate is a declarative commitment that guarantees that the timber has been treated according to product, penetration and retention characteristics that can be verified afterwards as part of a compliance check..

⚠ As of 1 June 2007, the REACH (Registration, Evaluation, Authorisation and restriction of CHemical substances) regulations restrict the use of biocidal products via maximum permitted concentrations in timber, given the harmful effects on both humans and the environment.

In particular, the following undesirable elements are being sought by supervisory authorities:

- Pentachlorophenol (PCP);
- Polychlorinated biphenyls (PCBs);
- Carbendazine, chlorothalonil, etc.;
- Heavy metals: lead, cadmium, mercury, etc;
- Restricted substances listed in annex XVII of REACH (compounds made of creosote, arsenic, chromium and cadmium, and compounds made of boron and its derivatives).

France's DGCCRF agency considers that green coloured timber (colour in the mass) may be subject to inspections for traces of copper-based treatments, such as CCA (Copper Chromium Arsenic) or CCB (Copper Chromium Boron) type products, organic copper or that which is copper oxyquinoleate-based. Note: this green colour is sometimes found in new formulations in the form of a dye, only to remind consumers of the performance of products which are now banned in Europe.

7. The autoclave is an enclosure in which vacuum and pressure cycles (using the Bethell process) cause the chemical to penetrate the timber to a greater depth than by soaking.

Moreover, as part of a permanent challenge, chemists are forced to develop new solutions that are the least biocidal as possible in compliance with regulatory requirements and the most biocidal possible according to industrial requirements. The effectiveness of these solutions is to be demonstrated in the laboratory in the absence of feedback from the field.

ⓘ These techniques make it possible to confer greater durability on timber of low natural durability or of lesser value. However, this conferred durability never reaches the level of the most naturally durable timbers in the long term (e.g. Azobé, Ipé, Teak, etc.), and any post-treatment machining exposes an area of timber whose durability will be lower than that expected. There is no way of restoring the initial level of protection in the field. (Dipping and autoclaving techniques are reserved for industrial preventive treatments, and not applicable to the re-treatment of cuts, which can only be done by spraying and brushing and which offers a lower level of protection).

CREOSOTE TREATMENT

Creosote is a commonly used product reserved exclusively for specific uses: the preservation of railway sleepers and railway sleepers and telephone poles. It differs from other chemicals in two main ways. First of all, the active substances are a collection of numerous molecules resulting from the distillation of coal (between 100°C and 500°C). Secondly, its application doesn't require any solvents; all of the introduced substance is intended to remain in the treated timber for the entire required service life.

⚠ The effectiveness of creosote is essentially due to the formation of toxic molecules and a few highly carcinogenic ones (soluble phenols and benzo[a]pyrenes in particular). Creosote treatments are regulated.

ISMP/NIMP 15 TREATMENTS

The International Standards for Phytosanitary Measures (ISPM/NIMP) are established by the International Plant Protection Convention (IPPC), which is part of the United Nation's Food and Agriculture Organization (FAO). This standard provides for measures to limit the risk that pests will appear and spread in timber packaging.

The treatment consists of heating the timber to a minimum core temperature of 56°C for at least 30 minutes. These conditions are lethal to insects in all their forms (eggs, larvae, pupae, imagos[8]). Kiln drying (KD, see the humidity sheet), is considered to satisfy this provision, provided that the prescribed target humidity values are achieved.

This is a **curative** treatment with no guarantee in time (non-preventive). Fumigation is another technique that meets this requirement.

FUMIGATION TREATMENT

Fumigation is a timber treatment that uses toxic gases: methyl bromide, hydrocyanic acid, hydrogen phosphide, ethylene oxide, carbon dioxide, etc. In France, this operation must be carried out by a company approved by the Ministry of Agriculture (list available from the DRAAF body).

8. Adult insect

THERMAL TREATMENT

The timber must first be dried before being placed in a controlled atmosphere, with inert gases (mainly nitrogen) and without oxygen to prevent the material from burning (oxidation). Then, the temperature is gradually increased to a maximum temperature of between 180°C and 250°C. The treatment modifies the most hydrophilic constituents. Lastly, the timber is cooled to room temperature. The total duration of the treatment varies between 10 and 25 hours depending on the timber variety, its thickness and the type of process that is used.

In this type of treatment, the cellulose molecules, starch and various sugars - which are the main food of decay fungi - are broken down. Also, humidity pick-up is greatly reduced and dimensional variations (shrinkage-swelling) are greatly reduced. For these reasons, the development of lignivorous or lignicolous fungi is generally more limited or even almost absent (depending on the thermal treatment process that is used). The timber is browner and smells «cooked». However, thermal treatment does not protect the timber from underground termite attacks.

⚠ Durability is further improved by the fact that the molecules that are preferentially eaten by xylophagous insects are broken down.

In this breakdown, the density, hardness and mechanical properties of the timber are reduced, which sometimes results in infestation by timber-boring organisms.
Singularities (cracks, knots, resin pockets, etc.) cause severe deterioration (deformations or cracks) during treatment. For this reason, timbers without any defects and that feature straight grain are usually selected. When growth rings are highly pronounced, ring detachment and splits are possible.
Full control of the homogeneity of the timber's density is a fundamental factor, without which the densest timbers will be «undercooked» and the least dense timbers will be «overcooked».
Lastly, the radicals that allow water molecules to cling are much rarer, which makes gluing or the application of finishes very difficult.

ⓘ Some manufacturers use the (sometimes protected) terms «retified wood» or «roasted wood» for this process.

ACETYLATION TREATMENT

Acetylation consists in the substitution of active hydrogen atoms (hydroxyl groups) for acetyl groups. Acetic anhydride is commonly used as an acetylating agent. It is also used in the synthesis of both aspirin and heroin.

The reaction of timber with acetic anhydride is an exothermic process9. The timber's temperature must be controlled in order to avoid thermal alteration. Also, the reaction generates acetic acid as a by-product, which must be extracted at the end of the treatment. Acetylation is a slow process that can be accelerated by the use of a solvent and/or a catalyst.

Timber varieties suitable for treatment by acetylation must have good impregnability. Timber varieties with low density (and low natural

ⓘ Some manufacturers market treated timber under a name that masks the original properties of the timber variety, for example: Accoya.

9. That releases heat

⚠ These same manufacturers claim that acetylation treatments provide «fast-growing timber varieties with properties equal to or superior to tropical timber varieties». However, the treatment is not effective throughout the entire mass (except in cases of thin layers and reconstituted timber), its stability over time remains to be demonstrated and the mechanical properties of acetylated timber will never reach those of tropical timber. Acetylation-treated products have only been introduced on the European market for less than a decade. It is therefore too early to guarantee performance over periods exceeding this time; the stability of acetyl groups facing temperature variations, UV rays or mechanical stresses (water erosion, pedestrian traffic, etc.) has yet to be demonstrated over the period of use.

FURFURYLATION TREATMENT

Furfurylation is a technique that impregnates timber with a furfuryl alcohol (and polyalcohol) solution which is then polymerised on the cell walls. Furfuryl alcohol is a derivative obtained from many plants (including bran, which carries the Latin name furfur).

Furfuryl alcohol molecules bind to timber under conditions of acidic pH and high temperatures (between 100°C and 150°C). Under these conditions, the lignin and cellulose that will receive the polymer breakdown. The furfurylated timber becomes hydrophobic and more durable against biological degradation agents. At the same time, this treatment leads to an increased density (WPG: Weight Percent Gain) of 0% to 125%, which is accompanied by enhanced hardness and mechanical properties and improved stability (reduced shrinkage coefficients).

ⓘ Ts with acetylation, the industry has chosen to market furfurylated timber under names that mask the original properties of the timber variety, such as: VisorWood or Kebony.
⚠ These products have also recently been introduced on the market and their durability over time cannot yet be guaranteed.Even though the mechanical properties of timber treated by this process are improved, they don't match those of the most resistant tropical timbers. Although furfuryl alcohols are obtained from plants, the «green chemistry» notion used to reassure consumers commercially, however, requires procedures and careful verifications.Furthermore, the evolution over time of these products (both furfurylated and acetylated) isn't fully understood yet, so we still need to consider potential medium- and long-term health risks (direct contact with users' skin, the progressive release of volatile compounds, etc.).

ASSESSING DURABILITY

The principle of laboratory testing is to place a material in direct contact with a biological degradation agent under optimal development conditions and to measure the deterioration of the material (by loss of mass). The tests are repeated with different agents, but they cannot be exhaustive or take into account synergistic effects between agents or with the immediate environment. «Accelerated ageing» consists in placing the material in severe environments (heat, humidity, dryness, UV rays, etc.) in alternation and by cycle. These two methods can give an idea of the actual behaviour of timber under regular use, but biological agents are living organisms that need time to develop. The performance evaluated in the laboratory is not always equal to that expected in the field. The durability of tropical timber is known through a usage experience that extends over several centuries.