TRADA
wood information

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SECTION 2/3 SHEET 32
SEPTEMBER 1991 (with Sheet 2/3-33, replaces Sheet 2/3-30: 1987)

Wood preservation - a general background

Part 1 - the risks

This Sheet outlines the more important types of fungi and insects. Since specifiers and processors increasingly are involved in the preservation of timber and wood based panel products to be used overseas, it is not written purely in UK terms, but paints a broader picture. With a rather cold temperate climate, the UK is not seriously afflicted by insect pests. Indeed, a major scourge of tropical and sub-tropical countries, termites, are absent altogether and another widely prevalent pest, the house longhorn beetle, has a very restricted distribution in the UK. Attack of timber or wood products by bacteria, soft rot fungi and marine borers is dealt with in other publications; see Further Reading. Preservative treatment is covered in Part 2: WIS 2/3-33.

TIMBER, FUNGI AND INSECT PESTS

Timber is composed primarily of hollow fibres of cellulose cemented together with lignin, a complex organic material constituting some 20% by weight of dry wood. The ratio of wood to air, the shape, variety and arrangement of the constituent fibres and the small proportion of loosely bound `extractives' vary to give timbers which differ widely (eg balsa to lignum vitae), mainly in terms of their physical and mechanical properties. The chemical constitution varies little except for the `extractives' which confer the specific properties of colour, odour and resistance to bio-deterioration by fungi and insects. Sugars and starch form part of the vital system of the living tree; they can persist in the log or converted timber for several years under the right conditions, and they can influence the susceptibility of timber to degrade by fungi and insects.

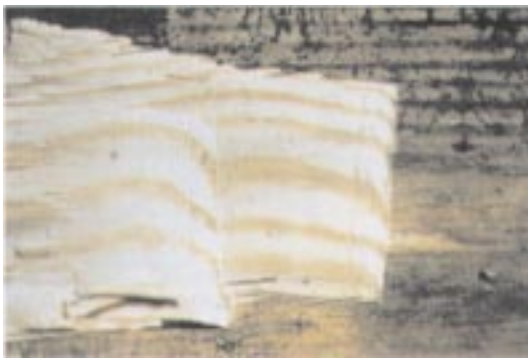
Fungi can cause staining, decay and weakening; insects disfigure the timber or render it unserviceable by boring holes in it or consuming it. Fungi require the timber to have a moisture content of at least 20% if they are to develop and cause damage. Some insects on the other hand can attack `dry' wood. In many situations of use, the moisture content of timber not in contact with the ground can be kept below the danger threshold for fungal attack by correct design and detailing to minimise wetting and to ensure continued weathertightness and adequate ventilation. Such measures do not, however, necessarily confer immunity to insect damage. It is for this reason that there is a role in wood preservation for formulations with insecticidal but not fungicidal properties. This is particularly the case in regions where termites are indigenous.

Some timber species are resistant to fungal and/or insect attack. Typically, only the inner, or heartwood, zone contains the extractives which give resistant properties to the wood. It follows that the outer `sapwood', is essentially unprotected from fungi and insects if the conditions for attack are satisfactory. This is important to bear in mind when the 'natural durability' of a timber is quoted. This is usually assessed on test stakes in ground contact, and relates only to the heartwood. The sapwood of most species is in the lowest two groups of the 5-category classification (from 'perishable' to 'very durable') for this property.

FUNGI

The spores of wood-decaying or staining fungi are widespread so that avoiding attack by sanitary measures is impossible. Long service life in an environment suitable for fungal development depends on high natural durability or effective wood preservation with fungicidal chemicals. The degree of preservative protection required to prevent infection from spores is less than that needed to prevent an existing fungal attack of wood or in the soil growing into adjacent sound timber.

Sap-stain fungi and moulds.



Surface mould growing on timber, but note that the wood immediately beneath the surface is still bright

Various fungi cause deep-seated (sap-or blue-stain fungi) or superficial (mould fungi) discolouration of damp timber and wood products. Both types feed on the cell contents and stored food reserves and are therefore confined to sapwood. They do not cause loss of strength but can reduce the value of timber or even render it unsaleable by spoiling its appearance. Even if arrested in its early stages by reducing the timber moisture content, sap-stain or mould attack can revive if moisture content increases and cause disruption of paint or varnish films in service. A moisture content greater than 25% is required for active sap-stain development, whereas mould growth can continue down to about 20%, or even lower if high relative humidity persists. Sap-stain is of greatest consequence with softwoods and light coloured tropical hardwoods such as obeche, ramin, celtis, jelutong and pterygota, all species where even the heartwood does not contain sufficient extractive to provide protection. Debarked logs are most susceptible but infection can enter via log ends, branch stubs, damaged bark or bark beetle holes. Converted timber is also susceptible.

Sap stain in the sapwood of Scots pine

Wet-rot fungi

Wet rot decay in window joinery due to poor detailing between the sill and brickwork

These fungi cause decay of wet timber and are sub-divided into white and brown rots. The former destroy both the cellulose and lignin components of the timber whilst the brown rots attack the cellulose and leave the lignin as a brown residue. Numerous species of fungi are involved worldwide, varying in their vigour, timber preferences and susceptibility to control by wood preservatives. The first line of control is to keep the timber moisture content below 20%. In certain end uses, such as poles, posts and sleepers, this is impossible and reliance must be placed on the use of naturally durable species or wood preservatives. In other situations, such measures are a back-up defence or form of insurance against the failure of design and maintenance measures. Wet rot fungi cause loss of strength and eventually complete disintegration. Their rate of development depends on temperature, moisture content, oxygen availability and the degree of resistance of the timber.

Dry-rot fungi

Dry rot attack in building

This title is a misnomer in that the fungi, which produce a brown rot type of damage, require timber at a high (20%) moisture content. Their distinctive feature is that they are able to translocate moisture and form their own wet zone in timber. They are typically inhabitants of humid, unventilated spaces in buildings and once established, are very persistent.

INSECTS

World-wide, the most economically important insect pests of wood products are the various forms and species of termites. A wide range of beetle species whose larvae tunnel in wood for food and protection comes a close second.

Termites

Termite damage in tropical hardwood poles

Termites are essentially a problem of tropical and sub-tropical regions but they also are found as a limited hazard to wood in service in some temperature countries, eg France, Japan, Korea, Germany. Their distribution is limited by low temperature due to geographical location and/or altitude. There are

two main types which attack timber in service; dry-wood and subterranean termites. Of the 1800 or so species so far described, 10% have been recorded as causing damage in buildings, and 53 species are serious pests in this regard, 10 being dry-wood types.

Termite attack in building timbers

Dry-wood termites live entirely inside the timber on which they are feeding, often hollowing large timbers but leaving a thin shell for protection. Attack, once begun, takes place largely within the timber and may be well advanced before being recognised. Prevention must take the form of using resistant or chemically treated timber since building design features are ineffective against flying insects. Eradication is usually accomplished by a fumigation treatment but such treatment does not confer long-term protection which must be provided by in-situ application of insecticides.

Subterranean termites live in nests in mounds or cavities in the ground. They do not produce frass as do the dry-wood termites and possess a different form of colony organisation. The nest sites may be hundreds of metres from the attack but movement is always within protective tunnels or runways constructed by the foraging workers from earth and chewed wood. Control of subterranean termite damage can be by the use of preservative treatment and/or design features to prevent entry from below ground. Species differ considerably in their distribution and voracity.

Beetles

Typical dark rimmed bore holes of Ambrosia beetle damage in sapwood

The most important beetle pests of wood and wood-based products, particularly in tropical and sub-tropical regions, belong to the Lyctidae family eg *Lyctus, Minthea.* The larvae form tunnels in the sapwood of solid timber or veneers of susceptible species. Susceptibility depends on two main factors; firstly the pores of the timber must be large enough in diameter to allow egg laying. This critical size varies with the species, but for *Lyctus brunneus* (a European species), is about 0.8 mm. Secondly it must have a high starch content for, unlike most wood-boring beetles, these insects feed on the starch stored in the sapwood which can be completely disintegrated if conditions are favourable. Light coloured, large-pored timbers, such as obeche and ramin are most susceptible. Softwoods, small-pored hardwoods and heartwood are not attacked. Lyctus beetles can cause damage to susceptible hardwoods in the UK often in local epidemics attributable to poor timber yard hygiene. This group is also responsible for the only significant insect attack of panel products (plywood) in the UK.

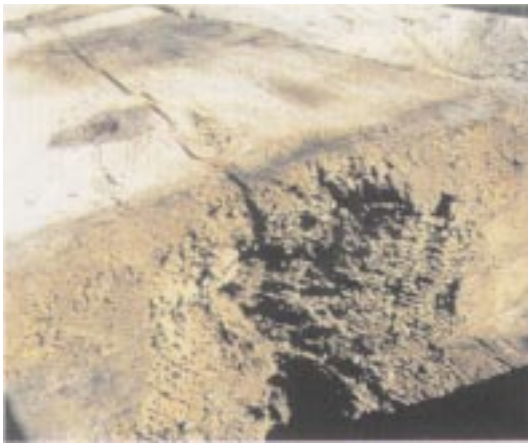
Lyctid beetles are often known colloquially as `powder post beetles', a name they share with the mainly tropical Bostrychid beetles which similarly produce powdery frass. Adult Bostrychid beetles bore short tunnels in which to lay eggs and so are not dependent on large-pored timber species. Attack is more readily detected early and protective measures can be put in hand. Logs and dried timber can be infested in the tropics. Both the adult beetles and larvae feed on the starch content of the sapwood of hardwoods. Imported timber infested with Bostrychid larvae is occasionally found in the UK but the attack quickly dies out and cannot spread.

Ambrosia beetles are small and infest freshly felled logs (or standing trees, if sickly or moribund). Attack by different species can occur in temperate or tropical regions, both softwoods and hardwoods being vulnerable. More than 1,000 species have been named. The damage, caused by the tunnelling of the adult beetles, is variously known as pinhole, pinworm or shothole and is characterised by small, circular holes with a dark lining and halo of stained timber. This colouration is caused by moulds which grow on the insides of the tunnels and on which the larvae and adult beetles feed. A high (over 35%) moisture content is required for this fungal `ambrosia' to grow so that infestation dies out when the timber is dried. Attack of freshly felled logs, however, can be very rapid: within a few hours, unless protective treatment is carried out. Ambrosia beetle attack can penetrate to the centre of a tree and is not restricted to the sapwood. Somewhat unusually, it is the adult beetles which do the boring, creating circular holes 0.5 - 3 mm diameter according to the species of beetle, the tunnels being across the grain of the wood. The attack does not persist in dried timber and there is no danger of spread or reinfestation in the UK.

Damage to softwood roofing timbers by the house longhorn beetle

Longhorn beetles are widely distributed in tropical and temperate regions. They attack green (ie wet,

freshly felled) and partially dried timber. Their name comes from the long antennae. Adults of some tropical species are 75 mm in length. Thus the oval tunnels which the larvae create can be large and destructive and so timber infested with this insect is rarely seen in the UK. Attack by forest longhorns can be prevented by prompt removal of bark from the felled logs but this process encourages Ambrosia beetle attack.



Death watch beetle attack in 15th Century church timbers

The house longhorn, *Hylotrupes bajulus* differs in its lifestyle from the forest longhorns described above, in that it infests and can reinfest dry timbers in service. It is a widely distributed species found in North and South America, South Africa and Europe. Damage is caused by the larvae which burrow into the timber from an egg laid on the surface. The larval stage can last up to 11 years and since a fully-grown larva can be 30 mm long, destruction of the timber can be extensive. Exit holes are oval and conspicuous. This is in contrast to the larval entry holes and the larval tunnelling which, although it may be very extensive and near the surface, is always behind a thin layer of undamaged wood.

In the UK the house longhorn is restricted by climatic factors to an area to the South-West of London where it is controlled by special provisions in the Building Regulations for preservative treatment of roof timbers.

Wood wasps are pests of sickly standing trees or freshly felled logs of coniferous trees. Eggs are laid through the bark and into the wood where the larvae which hatch from them, tunnel into sapwood and heartwood alike, pupate and eventually emerge as adults through circular flight holes. The fear of a wood-wasp epidemic is a major factor behind the strict quarantine regulations imposed by Australia on imported wood products. Although three species of wood wasp exist in the UK they are not a problem in practice.

Various members of the beetle family Anobiidae; *Anobium* (woodworm or furniture beetle), *Xestobium* (death-watch), *Ernobium,* are significant pests of dried timber in service. The larvae use the timber as a food source and cyclic reinfestation can eventually lead to structural failure of building components and furniture. The various species have different preferences for timbers, but they are able to infest dry timber of a wide variety of species. In many situations, preservative treatment with a contact-insecticidal formulation is the only practical preventative.

Common furniture beetle attack, showing a number of flight holes

In tropical and sub-tropical countries many other insects infest timber in its various stages of utilisation, causing degrade by structural weakening or marred appearance. Many are of local or sporadic occurrence so that only the most widespread and economically significant types have been introduced in this Sheet. Fortunately, the variety and vigour of insect pests of timber are much lower in temperate regions than in warmer parts of the world.

FURTHER READING FROM TRADA

Prices and a full list of publications are available on request

TIMBER PESTS AND THEIR CONTROL

Published jointly by TRADA and the British Wood Preserving Association

TBL 25 Revised 1984

A 60 page booklet which illustrates and provides information on the biology of the fungi, insects and marine borers which can attack timber. Emphasis is placed on the recognition of attack and on means of prevention.

WOOD INFORMATION SHEETS

2/3-33 Wood preservation - a general background. Part 2 Chemicals and processes

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