WOOD Protection Association

GUIDANCE ON THE TREATMENT OF

SPRUCE FENCE POSTS AND STAKES

Scope and References

This publication provides guidance on the preservative treatment of spruce fence posts and round stakes, destined for BSEN335:1 Use Class 4 ground contact applications, where the service life expectation is 15 years.

In producing this guidance note, reference has been made to relevant British and European Standards:

BS8417: Preservation of Timber. Recommendations

BSEN335: 1 Classification of Use Classes

BSEN350: 2 Guide to the durability and treatability of wood species

BSEN351: 1 Durability of wood and wood based products

BSEN351:2 Sampling for the analysis of preservative-treated wood

BS1722 Fencing standards

All the leading manufacturers of industrial wood preservatives have also been consulted.

1. Introduction

Preservative treatment makes it possible to increase the durability, performance and value of timber components. Without pre-treatment many wood species would be unsuitable for use in ground contact applications due to their low resistance to biological attack. Spruce is one of these species. However it is readily available and relatively low in cost, so it is economic good sense to maximise its use. For many potential applications preservative treatment is recommended but for outdoor applications it is an essential requirement of British (BS) and European (EN) Standards.

However, BS and EN standards also recognise that spruce is among the most difficult of species to treat effectively. Achieving results that will meet a customer's service life expectations takes more time and process awareness than with permeable softwoods. As the technical and advisory body for the wood protection industry in the UK, the WPA is committed to providing guidance on how best results are achieved. This document deals specifically with the treatment of spruce fence posts and round stakes.

2. Spruce

There are two common forms of spruce used in the UK, imported Norway spruce (*Picea abies*) and homegrown sitka spruce (*Picea sitchensis*).

Both species are classified as resistant to treatment in BS8417: Preservation of timber, but according to BS EN350-2:Guide to the durability and treatability of wood species, the treatability of Sitka spruce, rated as class 2-3, is slightly better than Norway spruce, rated as class 3 but variable.

BSEN335:1 classifies fence posts and stakes as a Use Class 4 application. Components will be in permanent contact with the ground or fresh water. As such the level of preservative treatment must be fit for the end use and desired service life. This is defined in BS8417.

In the 2006 revision of BS1722 fencing standards, the requirements for the preservative treatment of timber components were updated, making compliance with BS8417 essential to satisfying the needs of customers.

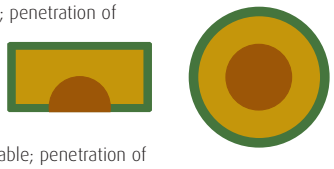
3. BS8417 preservative treatment

To achieve a 15 year desired service life in Use Class 4 ground contact applications, BS8417 requires the timbers to be treated to penetration class P4 (BSEN 351-1). Since spruce is classed as 'resistant', the recommended Acceptable Quality Level (AQL) defined in BSEN 351-2 is 25%. The AQL is the proportion of pieces in a treatment charge permitted to have less than P4 penetration. No tolerance is permitted in relation to preservative retention.

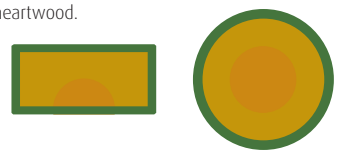
Penetration class P4 requires 6mm penetration into the sapwood, or 6mm throughout if it is impossible to distinguish between sapwood and heartwood for quality assurance purposes. See Figure 1.

Figure 1.

Heartwood is distinguishable; penetration of sapwood only.



Heartwood is not distinguishable; penetration of sapwood and any exposed heartwood.



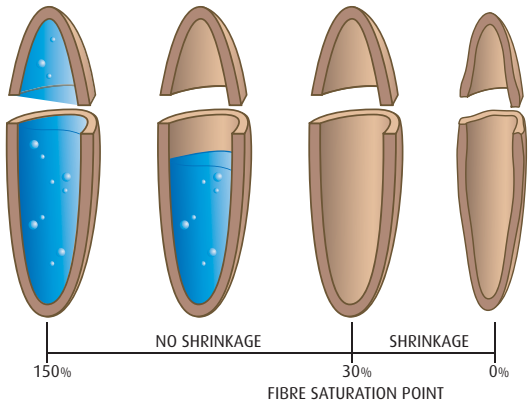
BS8417 defines treatment in terms of penetration and retention values. It does not give recommendations on appropriate moisture contents, processing schedules and other factors which may improve penetration.

This Guidance Note seeks to address these factors. The information provided is based on the technical knowledge and experience of the Wood Protection Association and is given in good faith and without warranty.

4. Appropriate moisture content

A maximum pre-treatment moisture content (mc) of 28% is the figure historically quoted for fencing. This is approximately the fibre saturation point of wood, the level at which there is no free water in the cell cavities - see Figure 2. This is optimum for vacuum pressure treatment since it permits preservative liquid to flood the cell cavity.

Figure 2. Fibre Saturation Point Cell Shrinkage

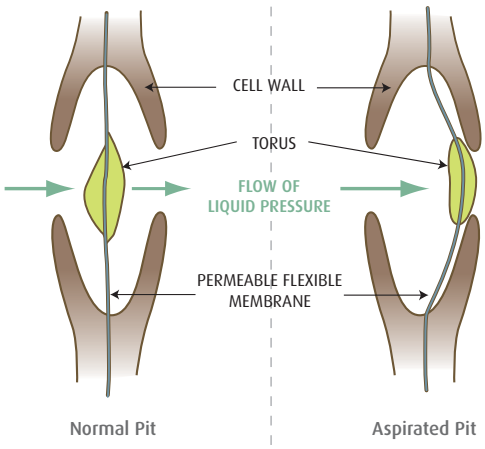


It is important to understand that timber moisture content relates to the dry weight of timber and freshly felled timber can have moisture contents as high as 150%. To dry spruce from 150% mc to 28% mc requires the removal of over 500 litres of water per cubic metre of timber. However, as detailed in section 6, the spruces may be more receptive to treatment at a moisture content above 28%.

5. Pit aspiration and its affect on treatment penetration

In a living tree, water passes laterally from one cell to another through a series of valves called pits. Some species such as the spruces, have what are called bordered pits and upon drying, these pits close and are termed aspirated - see Figure 3. Pit aspiration causes many of the problems associated with treating resistant timbers such as spruce, as it contains a larger proportion of aspirated pits than in more permeable species such as pine.

Figure 3. Section Through Pits



Pit aspiration with spruce generally increases during forced drying conditions such as kiln drying as opposed to air-drying. High temperature kiln drying to low moisture contents will dry the timber to what may appear to be an ideal moisture content for preservation but in terms of preservative penetration, this can be off-set due to an increased level of pit aspiration.

6. Drying Spruce

To achieve the necessary penetration and retention levels for preservation, it is clearly important to remove a large proportion of the water prior to treatment yet at the same time, for spruce, to minimise the extent of pit aspiration.

Practice has found that spruce will often treat better when dried to 30-40% mc and when air-dried rather than high temperature kiln-dried. Although this is higher than the normal optimum mc of 28% for softwood treatment, if pit aspiration is reduced, treatment of spruce at the higher moisture content will be advantageous.

Air drying/seasoning

Best practice is to store the timber in a weather-protected environment with sufficient ventilation to promote drying throughout the pack - see Figure 4. This will normally require stickering the timber every other layer.

Figure 4. Seasoning spruce rounds for treatment, Wales

7. Assessing moisture content

There are a number of ways of assessing moisture content (mc) in timber.

7.1 Moisture meter

The most commonly used way is to use an electrical resistance moisture meter. The type that allows the metal probes to penetrate into the wood are best. Readings should be taken from different positions in the pack and from both the outside and internal layers. A sufficient number of readings should be taken to give an overall indication of the mc of the pack. However, moisture meters are notoriously inaccurate above the fibre saturation point and cannot always be relied upon. Readings below fibre saturation point are accurate enough to assess suitability for treatment.

The procedure and sampling reccomendations for using moisture meters can be found in section 7.2 of the WPA Manual:*Industrial Wood Preservation, Specification and Practice.*

7.2 Oven dry method

The time honoured and most accurate way of determining mc is by what is known as "the oven dry method". This is a slow process and involves cutting or boring samples for weighing and drying. It is impractical for routine use in a busy timber yard but the procedure can be found in section 7.2 of the WPA Manual if required.

7.3 Weighing method

A more practical method for treaters to assess moisture content may be to use weight as a measure. As spruce dries it also reduces in weight and Figure 5 overleaf sets out a range of weights and equavalent mc levels that can be assumed.

Figure 5: Weights and moisture content per m³ (green sawn) Sitka spruce

Moisture content %	Weight range (per cubic metre green sawn wood) in kg
20	396 - 445
30	429 - 483
40	462 - 520
50	495 - 557
60	528 - 594
80	594 - 669
100	661 - 743
150	826 - 929

Note:

A) Calculation based on typical Sitka spruce densities given in BS EN 350-2: 400 - 450 kg/m³ at 12% mc (approx 375 – 422 kg/m³ dry density).

B) Swelling/shrinkage calculation, where required (to convert volume at 12% mc to green volume) is taken from information in the Handbook of Softwoods.

8. Other factors influencing preservative penetration

Penetration can be influenced by a number of other factors. These include:

- **mechanical incising**
- **using extended oscillating pressure treatment cycles**
- **biological organisms on the surface**

8.1 Incising

Incising is a pre-treatment mechanical process in which steel knives are used to make longitudinal incisions into the surface of timber prior to treatment. Some loss of mechanical strength is observed but incising is used commercially in America, New Zealand and in parts of Europe. Incising is an aid to enabling penetration in resistant species - it is not a substitute for drying the timber to an appropriate moisture content. See BRE publication IP13/05, Incising UK-grown Sitka spruce for further information.

8.2 Oscillating pressure treatment method

This was developed epecially for the treatment of high moisture content spruce timbers and has been used successfully in Germany. In the oscillating pressure process, the treatment vessel is flooded with preservative solution without an initial vacuum. After an initial pressure phase of 30 to 60 minutes, the dynamic pressure oscillation phase begins. At short intervals, the pressure and vacuum phases alternate, changing abruptly from one to the other. This oscillating pressure phase may last for as much as 10 hours with a minimum of 60 cycles. Standard vacuum-pressure treatment plants can be modified to operate these cycles.

8.3 Biological

Surface moulds and fungal staining do not decay timber but do have the ability to partially overcome pit aspiration. A small amount of mould and stain as may typically be seen on air-dried/seasoned timber can therefore be beneficial to penetration.

9. Preservative efficacy

When treated wood fails prematurely it can be for several reasons, often acting in combination. As a result of the regulatory approval process, the effectiveness of wood preservatives remains consistently high and reliable.

Before achieving approval for use in the UK all wood preservative formulations must demonstrate their efficacy. For wood destined for ground contact applications manufacturers must provide efficacy information based on biological testing as set out in BSEN599-1: *performance of preservatives as determined by biological tests*. The copper-organic formulations used for outdoor wood applications in the UK today have been in use in other wood treating markets outside of the UK since the early 1990's.

The benchmark for the performance of these products were the CCA (copper chrome arsenic) formulations that had been phased out of use by 2004 following an EU ruling restricting the use of arsenic. It is now almost 20 years since copper-organic preservatives were first approved for the treatment of ground contact timber and over this time, field test data are providing an increasingly powerful endorsement on the formulations efficacy. This data and experience is reflected in the guidance given to treaters by manufacturers about an individual formulation.

If there are any doubts about how best to meet service life expectations then the preservative manufacturer should always be consulted.

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