

ANNEX 2C

CEMENT BONDED PARTICLEBOARD (CBPB)



Description

Cement bonded particleboard (CBPB) was first commercially manufactured in the early nineteen seventies and has continued to be manufactured in relatively small quantities satisfying the requirements of specialised end-use applications. There are perhaps only about fifty of these mills world-wide each of which produces on average only about 200 m³/day.

The panel is a mixture of wood particles and Portland cement together with some additives. The first impression of the panel is that it is grey in colour, has a smooth almost polished surface and is heavy. This initial assessment of the panel fails to appreciate its outstanding merits especially in terms of reaction to fire, durability, stability, sound insulation and stiffness.

Composition

Following storage for at least 3 months, the debarked softwood logs of selected species are reduced to flakes some 10 to 30 mm in length and 0.2 to 0.3 mm in thickness using drum-knife flaking machines. After passing through a hammermill, the flakes are separated into surface and core material by screening, and are then mixed with Portland cement and water in the ratio by weight of: cement 60%, wood 20%, water 20%. Small quantities of chemicals are added to the wet mix; one of their purposes is to accelerate cement setting. The mat is formed in three layers, the outer layers comprising small chips. Unlike normal particleboard production in a multi-daylight press, the set of cauls in CBPB production must be kept under pressure until the cement has set and this is achieved by fixing a set of clamps to each set of cauls while in the press; these clamps are then released some 6-8 hours later after the set of cauls has passed through a heated chamber at 70 to 80°C. The panels are further dried before shipment.

It is the high mass of Portland cement which confers on the product its good reaction to fire behaviour, its very high durability (as a result of the panel having a pH of 11), its high stiffness ($E = 4500 \text{ N/mm}^2$), its very good sound insulation and its good dimensional stability relative to other wood-based composites.

Appearance

CBPB is readily identified from its mid grey somewhat polished appearance. The surface is very smooth, cementitious and devoid of wood chips; however, when heavily sanded the surface can appear very similar to that of resin-bonded particleboard. In cross section the chips, particularly in the middle layer of the panel, can be clearly seen: there are very few holes to be seen with the cement encasing the wood chips.

Density mass and sheet size

Panel density is a function of the percentage volume of cement used together with the degree of pressure exerted on the mat. Most manufacturers produce a panel with a minimum density of 1100 kg/m^3 . This means that a $2400 \times 1200 \times 12 \text{ mm}$ panel will weigh approximately 45 kg. This can give rise to handling problems, especially with thicker panels.

Panel sizes commonly available are $1200 \times 2440 \text{ mm}$ and $1200 \times 3050 \text{ mm}$ in thicknesses of 6 mm to 40 mm. Square edge panels are the standard; profiling is done to order.

Applications

Primarily because of its lay up, composition and mass, CBPB is mainly used for specialised applications in construction. Thus, its outstanding merits, especially in terms of reaction to fire, durability, sound insulation and stiffness, render the product most suitable for internal wall construction in public places, lining of lift shafts, construction of cabling ducts, soffits, motorway acoustic fencing and cladding of prefabricated house units.

Specification

CBPB manufactured in Europe must now be specified in accordance with the European standard (EN 634): the UK version of this is EN 634. As explained in Section 2 of PanelGuide, CBPB that is used in construction must comply (by law) with the Harmonised Standard for wood-based panels (EN 13986); this standard calls up EN 634 which is in two parts:-

- EN 634-1 Cement-bonded particleboards – Specifications–Part 1: General requirements.
- EN 634-2 Cement-bonded particleboards – Specifications–Part 2: Requirements for OPC bonded particleboards for use in dry, humid and exterior conditions.

Guidance on the selection of CBPB is given in tabular format in Sections 2.3 to 2.14 of PanelGuide.

Physical properties

a) Climate

Like other wood-based panel products, CBPB is hygroscopic and its dimensions change in response to a change in humidity; in terms of thickness, the extent of dimensional change is only about 5 percent that of wood-based panels bonded with an organic adhesive. A 1% change in moisture content increases or decreases the length, width and thickness of CBPB by the amounts set out in the table below.

Dimensional change for a 1% change in panel moisture content (DD CEN/TS 12872)

| Type of panel | Specification | Dimensional change at 1% change in panel moisture content | | |
|---------------|---------------|---|---------|-------------|
| | | Length % | Width % | Thickness % |
| CBPB | EN 634 | 0.05 | 0.05 | 0.04 |

As a guide, CBPB can be expected to attain the following moisture content under the following specified conditions.

| <i>Relative humidity at 20°C</i> | <i>Approximate equilibrium moisture content</i> |
|--------------------------------------|---|
| 30% | 5% |
| 65% | 10% |
| 85% | 14% |

Like other wood-based panels, it must be conditioned to bring it into equilibrium with its environment before it is fixed. This is usually achieved by loose stacking the panels in the room where they will be used prior to fixing them. The time required for the panels to achieve equilibrium moisture content will vary depending upon the temperature and relative humidity in the building. It is difficult to achieve an exact equilibrium moisture content with CBPB as it continues to gain weight (and strength) with time due to carbonation. The likely equilibrium moisture content of CBPB in various conditions are as follows:

| | |
|--|-----------|
| In a building with continuous central heating: | 5-7% |
| In a building with intermittent central heating: | 8-10% |
| In an unheated building: | up to 15% |

b) Biological attack

CBPB because of its high alkalinity (pH 11) will not normally be attacked either by wood boring insects common in temperate or tropical climates or by fungi even at high moisture contents.

General guidance on the use of preservative treatments for panel products can be found from the Wood Protection Association manual 'Industrial Wood Preservation – specification and practice Commodity Specification C11. This guidance helps make the right choice of preservatives for the end use and the panel product to be treated as not all panel products need to be treated for particular end uses or are indeed suitable for some treatments. It also stresses that the preservative and/or the panel manufacturer should be consulted before any treatment is carried out as treatment may alter the physical and/or visual properties of the panel product.

c) Water vapour 'permeability'

The value of the water vapour resistance factor (μ) for CBPB varies with the method of determination (EN ISO 12572) as set out in the table below which is an extract from EN 12524 and EN 13986.

| | Mean density | Vapour resistance factor | |
|------|-------------------|--------------------------|---------------|
| | Kg/m ³ | Wet cup μ | Dry cup μ |
| CBPB | 1200 | 30 | 50 |

d) Thermal conductivity

The thermal conductivity (λ) of CBPB as determined according to EN 12664 is 0.23 W/m.K for a mean density of 1200 kg/m³ as set out in EN 13986.

e) Reaction to fire

Under the new Euroclass system for characterising the reaction to fire performance of materials, an untreated CBPB may be assumed to achieve the following:

| Product | EN Product standard | End use condition ⁽²⁾ | Minimum density (kg/m ³) | Minimum thickness (mm) | Class ⁽³⁾ (excluding floorings) | Class ⁽⁴⁾ (floorings) |
|--|---------------------|-------------------------------------|--------------------------------------|------------------------|--|----------------------------------|
| Cement-bonded particleboard ⁽⁴⁾ | EN 634-2 | Without an air gap behind the panel | 1000 | 10 | B-S1, d0 | B _{fl} -s1 |

⁽¹⁾ Mounted without an air gap directly against class A1 or A2-s1, d0 products with minimum density 10kg/m³ or at least class D-s2, d2 products with minimum density 400 kg/m³.

⁽²⁾ A vapour barrier with a thickness up to 0,4mm and a mass up to 200 g/m² can be mounted in between the wood-based panel and a substrate if there are no air gaps in between.

⁽³⁾ Class as provided for in Table 1 of the Annex to Decision 2000/147/EC.

⁽⁴⁾ Class as provided for in Table 2 of the Annex to Decision 2000/147/EC.

NOTE The classes given in this table are for unjointed panels, T&G jointed panels installed according to DD CEN/TS 12872 and fully supported joints installed according to DD CEN/TS 12872.

If the manufactured product does not satisfy any of these minimum requirements then it must be tested and classified according to EN 13501-1.

Further information on the reaction to fire testing products in both the BS and EN systems is provided in Section 2.2.3.

Storage and handling

Careful storage and handling is important to maintain panels in their correct condition for use; thus, CBPB must be protected from rain and accidental soaking. During transport, it is particularly important to keep edges well covered. Panels should be stored flat in an enclosed, dry building. When handling panels, the edges and corners should be protected against damage and care should be exercised in the carriage of thin sheets.

Detailed guidance on the storage and handling of wood-based panel materials is given in DD CEN/TS 12872 and Section 4 of PanelGuide.

Working with CBPB

CBPB should be cut by power saw and machined (routed, spindled, planed and bored) with normal woodworking machinery fitted with tungsten carbide cutting edges. Dust extraction equipment must be employed in enclosed spaces.

a) Mechanical joints and fixings

Wherever possible, fittings that depend upon face fixing should be selected; fittings that depend upon the expansion of a component inserted into the panel edge should be avoided.

Conventional woodworking fixings and techniques can be applied to CBPB which provides good holding power for screw fixings into the panel faces. Edge screwing is possible; in panels >16mm in thickness, pre-drilled holes are required. Countersunk parallel core screws should be used in both edge and face fixings because they have greater holding power than conventional wood screws. A high ratio of overall diameter to core diameter is desirable. Because of the high alkalinity of the panel, stainless steel or galvanised screws with a diameter up to 4.2mm should be used.

Drill pilot holes for all screw fixings. Typically, the holes should be 85 to 90% of the screw core diameter. Fixings into the panel face should not be within 15mm of edges of panels up to 16 mm in thickness (20 mm for panels up to 22 mm in thickness) and within 40mm of the corners.

Manual nailing of serrated or twisted nails up to 3.1 mm in diameter is possible in panels up to 12 mm in thickness. Above 12 mm, either predrilled manual insertion or non-predrilled pneumatic fixing should be used. Nails must be flat headed and galvanised, sheradised or of stainless steel.

Panels can also be fitted together using galvanised or stainless steel clips.

Further information on working with CBPB is included in Section 4.4 of PanelGuide.

b) Adhesive-bonded joints

A wide variety of jointing methods can be used, provided the following simple guidelines are observed:

- The joint parts should be accurately machined.
- Use sharp cutters to avoid tearing or burnishing the surfaces to be bonded.
- Use a high solids content adhesive with low flowing properties such as cold setting resorcinol formaldehyde
- Locate mating pieces accurately and hold them under pressure while the adhesive sets
- The width of grooves machined in CBPB should be limited to about one-third of the thickness of the board. The depth of groove is typically about one-half of the board thickness.
- Allow adhesive-bonded joints to condition for several days before sanding and finishing; this avoids the appearance of sunken joints and is essential with high-gloss finishes.
- A tongue and groove joint is very efficient, provided the fit of the joints is not too tight to cause a split along the edge.
- When attaching lippings, the tongue should be machined on the solid wood piece.

c) Finishing

Where very smooth surfaces are required pre-sanded panels should be specified. Further information on finishing CBPB is provided in Section 4.7 of PanelGuide.

Health and safety

a) Dust

CBPB will generate large quantities of very fine dust when it is machined and is a potentially hazardous substance and must be controlled.

Dust from cutting operations can be controlled adequately by complying with the Control of Substances Hazardous to Health (COSHH) Regulations 2002. Under these regulations wood cement dust has a Workplace Exposure Limit (WEL) of 5mg/m² expressed as an 8-hour time-weighted average. Exposure must be reduced as far as possible below this limit, usually with properly designed and maintained dust extraction equipment fitted to woodworking machines.

Extraction equipment is often not practicable or even available when using portable or hand-held tools, so a suitable dust mask (for example, Type FFP2 to EN 149) should be worn. If possible, work in a well-ventilated place.

Further information on dust is given in Section 6.3 of PanelGuide.

b) Formaldehyde

Uncoated CBPB manufactured using Portland cement does not require to be tested for formaldehyde and is automatically rated as E1. Uncoated panels produced in the UK therefore, have an E1 rating.

c) Hazards and control

In sheet or processed form, CBPB is non-classifiable under the COSHH regulations. However, there may be handling hazards, especially so on account of its high density.

COSHH Regulation 6 requires an assessment to be made (and normally recorded) of health risks associated with wood dust or formaldehyde together with any action needed to prevent or control those hazards.

The table below gives the most common hazards and identifies control methods to minimise the risk of harm actually occurring.

Common hazards and methods of control

| Activity | Hazard | Control |
|---|---|--|
| Manual handling (in full sheet form) | Large sheet sizes present a risk of strain or crush injuries if not handled correctly. | Store carefully in uniform stacks on a flat level base. Use mechanical handling equipment Adopt correct manual handling procedures. |
| Carpentry work Activities likely to produce high dust levels include: <ul style="list-style-type: none">• Sanding by machine• Sawing, routing and turning• Hand assembling machined or sanded components | Wood cement dust in general (including dust from CBPB) may cause dermatitis and allergic respiratory effects. | Off site: preparation under exhaust ventilated plant. On site: enclosure and exhaust ventilation. Dust extraction on portable tools. Good ventilation. Respiratory protection equipment. <i>Note:</i> Any health hazards arising from the use of CBPB at work can and should be controlled by compliance with the requirements of the Control of Substances Hazardous to Health (COSHH) Regulations 2002. |