TRADA

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WOODINFORMATION

Introduction to wood-based panel products

Wood-based panel products are sheet mate ri als which con tain a sig nifi cant amount of wood in the form of strips, veneers, chips, strands or fibres. The categories usually recog nised within this group of board mate ri-als and included in this sheet are:

- Plywood, includ ing blockboard and laminboard
- Particleboard, includ ing wood chipboard, flaxboard and wood cement particleboard
- Ori ented strand board
- Fibre build ing boards, includ ing medium den sity fibre board.

Ply wood was devel oped to pro vide panels with dimen sional sta bil ity and good strength properties both along and across the sheet. Straight, well grown timber is required for ply-wood manufacture.

Wood chipboard and fibre building boards were devel oped to pro vide util ity sheet mate ri als with uni form prop er ties. They often uti lise forest thinnings, lower quality trees or sawmill waste. From these has developed a whole family of panel products cater ing for a wide vari ety of end uses.

Ply wood, particleboards and fibre build-ing boards all include both gen eral pur pose or util ity boards and spe cial pur pose prod ucts.

This Wood Information Sheet provides a broad introduction to wood-based panels by outlining the manufacture and characteris-tics of the basic types and also indi cates some of the spe ci al ity prod ucts derived from them.

Wood-based panel prod ucts are now cov-ered by a series of BS EN Standards. Unlike the previous British Standards which were largely prescriptive and based on manufac-turing requirements, BS ENs are based on performance requirements. Each category of board material has its own set of Standards which generally follow a similarpattern:

- a general standard, defining the board and the requirements for tolerances on sizes, thicknesses, density etc as appro-priate. This standard will usually refer to other standards for test or measuring parameters.
- a standard (which may be published in sep a rate parts) which defines the require-ments for boards suitable for use in dry, humid and exterior conditions. The spe-cific conditions are defined by means of 'hazard classes'. The requirements may be further refined for loadbearing and non-loadbearing boards. The tests on which these requirements are based are set out in fur ther stan dards for each cat e-gory of board.

There is thus quite a complex matrix of inter-related standards. To assist users in understanding the new approach and the relationship between standards, TRADA has published Wood Information Sheets for the major cat e go ries of mate rial. These WI Sheets outline the BS ENs and are referenced in the appropriate section of this Sheet. The stan-dards are not dis cussed in detail here.

Plywood (Veneer Plywood)

What is it?

Veneer plywood (the correct term for what is usually called plywood) is defined as plywood in which all the plies are made of veneers orientated with their plane par al lel to the sur face of the panel.

The term ply wood also includes core ply woods such as blockboard and laminboard and is a 'wood based panel product consisting of an assembly of plies bonded together, some or all of which are wood'. The direc tion of the grain in adja cent plies is normally at right angles, with the outer and inner plies placed sym met ri cally on each side of a cen tral ply or core. How ever, as long as veneer ply-wood is 'balanced' about its centre line, plies may consist of two adjacent veneers bonded with their grain par al lel.

How is it made?

The practice of cross laminating veneers for special end uses can be traced back to the Egyp-tian Empire. Their crude forms of plywood were bonded with natural adhesives such as animal glue and blood albumen. Techniques changed little until the late 19th century when the rotary peeling machine (lathe) was invented. Standard plywood veneer is still produced using a lathe, which peels a log rather as a blade pencil sharp-ener works. Most decorative veneer is sliced from flitches after the log is cut into quar ters.

Production

Production details vary depending on factors such as the size and spe cies of log, the type of ply-wood produced and the scale of operation but the fol low ing sequence of pro cesses is typ i cal.

Log con di tioning

Conditioning involves soaking in cold or hot water or steaming. It ensures that the log is at a high and consistent moisture content throughout which facilitates peeling and helps yield smooth veneer with less ten dency to split or tear.

Peeling

The log section is rotated against the lathe blade which lies against the full length of the log pro duc ing veneer of con sis tent thick ness.

Clipping

The ribbon of veneer passes from the lathe through manual or automatic clipping machines which cut the veneer to size, or into smaller strips if defective material has to be removed. In some mills, clip ping is done after con tin u ous rib bons of veneer have been dried.

Drying

The wet veneer is fed through a drier to reduce its moisture content to about 4 - 8%. This facili-tates bonding of veneers and minimises warping of the fin ished ply wood. Driers may be con tin u ous or batch according to the age of the plant and whether rib bons or clipped veneer are being dried.

Jointing or veneer repair

Small strips of veneer may be jointed into full-size sheets by edge gluing, stitch ing or using perforated paper adhesive tape. Open defects, such as knot holes, may be repaired using plugs or filler to upgrade the board in accordance with grad ing rules.

Grading

The dried, clipped or reconstituted veneers are sorted into grades, usually by visual inspec-tion.

Adhesive application

Synthetic resin adhesive is applied by roller spreader, spray, extrusion or curtain coating and veneers are assembled with the grain of each at 90° to the adja cent veneer. (Ply wood with spe cial char ac ter is tics is pro duced when this rule of bond-ing at right angles is not fol lowed.) The resul tant assem bly is known as a lay-up.

Pressing

A cold pre-pressing stage is often used to con-solidate the lay-ups to prevent veneers slipping whilst the lay-up is han dled and to encour age the trans fer of wet adhe sive. The lay-ups are then sub-jected to pressure and heat in batches, in a multi-opening press.

Trimming, fill ing and sand ing

After cooling, each panel is trimmed. Where required, surface defects may be filled or repaired and most ply wood is then sanded.

Standards

Plywood is usually manufactured to the national standard of the country of origin. Ply-wood British and European Standards relating to ply wood are listed and out lined in Wood Infor ma-tion Sheets:

WIS 2/3 – 48 Plywood – Key standards listing

WIS 2/3 – 49 Plywood – European standards

WIS 2/3 – 50 Plywood – European standards – Test methods.

Plywood produced in accordance with BS EN 636 must be appropriately marked. Specifiers should satisfy themselves that plywood complies with the relevant BS ENs or that the required level of performance can be demonstrated in other ways.

General Performance Levels

Plywood is a versatile product that can combine attractive surface appearance with superior performance under hazardous conditions whilst retaining comparatively high strength to weight properties.

Plywoods are produced with glue bonds which range from those suitable only for interior use to those which will withstand external exposure. Further details are given in WIS 2/3 – 49 and in the WIS Specification and treatment of exterior plywood.

Two main types of glue are used for plywood manufacture:

- Ureaformaldehyde
  Boards made with this type of glue are suitable for interior use. Some boards may also be suitable for use in humid environments but not for use in exterior situations.
- Phenol formaldehyde
  Boards made with this type of glue are suitable for use in humid or in exterior situations. The durability of the veneer species should also be taken into account when selecting plywood for such uses.

A third type of adhesive, urea-formaldehyde fortified with melamine and known as '**MUF**' is used in some types of plywood. Bonds tend to be intermediate in resistance to moisture/weather. However, some reputable continental manufacturers make exterior or even marine plywoods with melamine based adhesive.

Types of plywood commonly available in the UK

Marine plywood (BS 1088/4079)

Marine plywood is manufactured using timbers classified as moderately durable or better (or exceptionally gaboon) and with high quality veneers bonded using phenol-formaldehyde adhesive. These plywoods are available from UK, Israel, France, Singapore, Malaysia and other sources.

Structural plywoods

Plywoods which are suitable for structural use are included in *BS 5268-2 The structural use of timber. Part 2 Code of practice for permissible stress design, materials and workmanship*. They are manufactured to national Standards which ensure minimum strength properties in the finished product and are subject to approved quality control procedures. Currently such plywoods are available only from Canada, Finland Sweden and the USA.

Utility plywoods

Utility plywoods comprise non-structural plywoods that are available in a surface appearance grade suitable for joinery, furniture and limited exterior uses. These plywoods are available from East and South East Asia, Brazil, France, Israel, Bulgaria, Czechoslovakia, Romania, Spain, Portugal, West Africa and other countries.

Decorative/overlaid

Special end-use plywoods are commonly available from Finland, Canada, USA, Malaysia, Singapore and other East and South East Asian countries.

Blockboard / Laminboard (Core plywoods)

What are they?

Composite boards having a core made up of strips of wood each not more than 30 mm wide, laid separately and glued or otherwise joined together to form a slab, to each face of which is glued one or more veneers with the direction of the grain of the core strips running at right angles to that of the adjacent veneers.

How are they made?

The technique of manufacturing blockboard and laminboard developed alongside the plywood industry from the turn of the century. Blockboard uses strips of wood about 25 mm wide for its core, whilst laminboard cores are composed of strips of veneer on edge (or occasionally strips cut from plywood). Plymills may introduce block or laminboard manufacturing facilities to use residues and to produce lower cost utility types of boards suitable for some interior purposes. The method of production is similar to that for plywood and the 'wet' stages of veneer manufacture are identical. The basic stages are as follows:

Core stock production

Blockboard core slabs are obtained from sawmill slabs and other similar residue, peeler cores or specially purchased logs. This material is sawn into planks, dried and subsequently cut into strips. Laminboard cores are cut from sheets of veneer no thicker than 7 mm, laid up into packs with the grain parallel and cut into strips of width equal to the thickness of the core. Some laminboards use cores cut from plywood in which case not all the veneers run parallel with the board surface.

Core slab

The strips are assembled into solid slabs, usually on an automatic forming line. In laminboard and some types of blockboard the core pieces are glued together.

Assembly

Veneers are bonded to the slab using synthetic resin adhesives, usually urea formaldehyde.

Pressing

The lay-ups of glued veneer and core slab usually go directly into a platten press, where the adhesive is cured under controlled pressure and temperature.

Trimming and sanding

After cooling, each panel is trimmed and sanded to precise dimensions.

Standards

Blockboard and laminboard are not commonly marketed as being in accordance with any Standard. BS 3444: 1972 Specification for Blockboard and laminboard defines grades and qualities.

General Performance Levels

Two types of blockboard and laminboard are generally available:-

- 3-ply construction
  has core slabs sandwiched between one, usually thick, veneer on each face. The result is a relatively low grade panel in terms of both appearance and strength properties. These panels are normally used for applications where they will be out of sight: where structural requirements are low; or where further surfacing (eg with melamine laminate) is to be added.
- 5-ply construction
  has core slabs sandwiched between two veneers on each side. Usually the inner veneers are 'core' or low grade veneers and the outer veneers are high quality utility veneer or decorative veneer. Such panels have superior appearance and strength. They provide a smooth, even substrate for high quality finishes and laminating.

Wood Chipboard

What is it?

A particleboard made of small wood particles and a binder (synthetic resin). Boards are available typically from 3 to 50 mm thick and may be of uniform construction through their thickness, of graded density or of distinct 3 or 5-layer construction.

How is it made?

Wood chipboard development started before World War II, following the discovery of synthetic thermo-setting adhesives. It is not as demanding in terms of raw materials and skilled labour as plywood, and wood chipboard mills are now located in most countries of the world. Production involves mechanically breaking up wood and reconstituting it using synthetic resin adhesives. The process is highly automated and most woody parts of a tree are usable. The basic stages of production are:

Debarking

Where chips are produced from logs, debarking may be carried out prior to chipping.

Chipping or milling

Solid wood raw material such as forest thinnings and sawmill slabs are cut to predetermined lengths and fed into a chipper. Planer shavings and similar waste is milled to the required particle size. Surface and core chips are often prepared in different ways and held in separate silos.

Drying

Wood chips are passed through a dryer to reduce their moisture content to about 2.5% to facilitate gluing and hot pressing. Core and surface chips may be dried to slightly different moisture contents.

Sifting/particle classification

Particles are graded to produce a 'furnish' with a specified mix of particle sizes. Oversize chips are re-milled. Fine dust is removed and this may remove much bark.

Glue blending

Dry chips are blended with synthetic resin, usually urea formaldehyde or MUF, and with other appropriate additives such as hardener, wax emulsion and fungicide. Proportioning of glue and chips has to be very exact and may be deliberately varied, surface chips often having higher glue contents.

Mat forming

A mattress of wood chips coated with adhesive is formed by dropping them onto caul plates or belts. Depending on the type of mat-forming machinery this will produce either homogeneous, graded density or layered mats.

Pressing

Pre-compressing is commonly carried out and then the mat is further compressed to a predetermined thickness in a high pressure and temperature press, which may be multi-daylight, single daylight or continuous.

Trimming and sanding

After cooling, each panel is trimmed and then sanded to precise thickness.

Extruded Chipboard

Most wood chipboard is produced by processes similar to those described above, but there are also boards formed by extrusion. Extruded boards are made by forcing the particle and resin mix through a wide heated die. The particles align themselves with their longer dimension at right angles to the direction of extrusion. These boards are only suitable as core for panels, doors, etc.

Continuous Pressing

The 'Mende' process is used to produce a continuous ribbon of chipboard where the mat is compressed between two moving belts; the gap between tapering down to the final board thickness.

Standards

Chipboard is frequently manufactured to the national Standard of the country of origin. British and European standards relating to particleboards are outlined in the Wood Information Sheets:

WIS 2/3 – 41 Particleboards – Key Standards listing

WIS 2/3 – 42 Particleboards – European Standards

WIS 2/3 – 43 Particleboards – Europeans Standards – Test methods

General Performance Levels

Six categories of board are defined by the BS EN standard for chipboard. They range from boards suitable for general purposes, interior fitments and furniture, through loadbearing types for use in interior and humid conditions. Chipboard is not suitable for exterior use.

Other particleboards

The technology of manufacturing chipboards with raw materials other than wood chips, ie flax shives, bagasse, etc, evolved from that used for wood chipboard.

Flaxboard is manufactured from shives obtained from the flax plant and is frequently complementary to linen fibre manufacture. Bagasse is the fibrous residue left after extraction of sugar from sugar-cane. Its production is seasonal, coinciding with the cane harvest.

Wood cement particleboard

What is it?

Wood cement particleboard is made from small particles of wood, bonded with either Portland or magnesite cement, formed and cured into panels.

How is it made?

In the early 1970's, the first plant was set up to produce dense wood cementboard in Switzerland and since then there has been a gradual increase of plants in both South East Asia and Europe. Wood cementboard production differs from other particleboards because the wood content of the

product is low (about 20-30% by weight), and the pressing does not use high temperatures. The process is basically as follows:-

Raw materials

Logs are stored for about two months to neutralise extractives in the wood that may retard cement curing. Bark is removed from all logs.

Flaking and milling

Logs are fed into a flaker. The flakes are then refined to suitable dimensions in an attrition mill and stored in silos.

Sifting / screening

Core material is separated (larger particles) from the surface material (smaller, finer particles). Also, at this stage, oversize particles are re-cycled back to the attrition mill and excessive fine dust is drawn off.

Blending

Wood particles, cement, water and chemicals are blended together.

Forming

The wet mix is spread on to caul plates.

Pressing and curing

The formed mats and caul plates are stacked in a clamping device to form a package where initial setting of the cement occurs; then the clamp is released. The stacks remain in setting chambers for about eight hours to control final curing.

Trimming, Maturing / conditioning

Boards are trimmed to size. They remain in a curing warehouse for up to 18 days and are then conditioned to an equilibrium moisture content.

Standards

The BS EN standards for cement-bonded particleboard are covered in the Wood Information Sheets relating to particleboards.

General Performance Levels

Wood cementboard has a density of 1000-1200 kg/m3 or approximately twice that of plywood and about 1.75 times the density of standard grade wood chipboard. This imposes restrictions on the end use of such a product. There can be difficulties encountered in cutting, machining and breakage, but claimed advantages over other wood-based panel products are:-

- Superior dimensional stability in wet conditions and retention of smooth surface
- Superior behaviour in fire
- High resistance to fungi, insects and weathering
- Good sound absorbance.

Oriented Strand Board (OSB)

What is it?

Oriented strand board is made from large wood strands having a length at least twice their width, which are orientated in predetermined directions in each layer to simulate some of the characteristics of plywood.

How is it made?

Early manufacture was based on waferboard production (using rectangular wafers), starting in 1962. During the 1970s a German company, Bahre-Bison, developed a process of producing wood strands and of aligning these strands either along the length of the board or at right angles to it. This board product was termed Oriented Strand Board and has now largely replaced waferboard. OSB production has many similarities with standard chipboard manufacture.

Debarking

Logs have their bark removed if the proportion is above that allowable.

Waferising, strand cutting and drying

Logs are cut to length and put into a wafériser which reduces them to strands which are cut parallel to the grain and dried in a tumble drier.

Blending

Phenol formaldehyde (PF) adhesive or melamine urea formaldehyde (MUF) adhesive is mixed with the wood furnish with a proportion of wax in a rotary blender.

Mat forming

The mat-forming section of an OSB production line orientates the strands of the first layer in

mainly one direc tion. The second layer is then orien tated at right angles to it and so on. Phys i cal or elec tro static meth ods of ori en ta tion can be used.

Pressing

The resinated mat is cured and pressed to a required density and thickness, usually in a multi-daylight press.

Trimming. con di tion ing and sand ing

After cool ing, boards are trimmed to size, con-di tioned and sanded, accord ing to require ment.

Standards

The BS EN standards for OSB are covered in the Wood Information Sheets relating to particleboards.

General Performance Levels

OSB is widely used for wall sheathing, floor-ing underlays, roof sheath ing and deck ing. It is not recognised in BS EN standards as being suitable for exte rior use. Boards are avail able in four grades from general purpose to heavy duty for loadbearing use in humid con di tions.

Fibre Building Boards

What are they?

Wood-based panel products usually exceed-ing 1.5 mm in thick ness, man u fac tured from fibres of ligno-cellulosic mate rial.

Two basic types of board are produced; wet process and dry process boards. In wet process boards, the primary bond derives from the felting of the fibres and their inherent adhesive proper-ties.

MDF (medium density fibre board), a 'dry pro-cess' board, can be defined as 'a sheet material man u fac tured from fibres of ligno-cellulosic mate-rial felted together with the pri mary bond nor mally derived from a bonding agent. Other agents may be added during or after manufacture to modify the par tic u lar prop er ties of the mate rial.'

How are they made?

The ear li est fibre build ing boards, pro duced in the late 19th cen tury, con tained large amounts of repulped news print and were of rel a tively low den-sity. Some what later, insu lat ing boards were pro-duced from ground wood pulp. During the 1920s and early 1930s further techniques were devel-oped to break solid wood down into fibres and reconstitute these under heat and pressure as a strong and dura ble panel hard board.

Wet Process Manufacture

This is the most common tech nique for man u-fac tur ing hardboards, medium boards and insu lat-ing boards. The ini tial stages of pro duc tion are the same for each type, but the later stages, after mat form ing, differ. The pro duc tion pro cess is basi cally as fol lows:-

Chipping

The raw mate rial, eg forest thinnings, saw mill waste, ply wood peeler log cores, is chipped.

Reduc tion to fibres

This is most often performed by the 'Defibrator' method. The chips are soft ened by pre-heating in low-pressure steam and then fed by Archi me dean screw between seg mented grind ing discs, one of which rotates at great speed.

Stock

Water is added to form a slurry. Additives to improve par tic u lar prop er ties may be added to the stock.

Board (wet lap) form ing

Pulp stock is laid on to a moving wire mesh and water removed by gravity, suction and the action of thicknessing rollers to produce what is termed a 'wet lap' in which the fibres are inter-locked or 'felted'.

Pressing and curing hardboards and medium boards

Wet lap is cut to press lengths and trans ferred on to wire mesh plates before being pressed in a heated multi-daylight press. Press closure drives the remaining water out through the mesh and compresses the mats, whilst the heat promotes fibre to fibre bonding. After pressing, the boards are further cured and conditioned to a suitable mois ture con tent in heat treat ment and humid i fy-ing cham bers.

Curing Insulating boards

Lengths of wet lap are conveyed through ovens to dry out moisture and re-establish the natural bonding.

Finishing

Boards are cut to size and may undergo further processing such as painting, machining into ceiling tiles or acoustic boards.

'Dry' process manufacture (MDF)

The dry process for manufacturing fibre building boards was developed from the traditional wet process and the fibre is produced in the same way. Differences in the production process are:

Resin application

Adhesive, usually urea formaldehyde, and wax emulsion are applied to the fibre within the inlet pipe to the drying tube.

Drying/storage

Drying of the fibre/adhesive mix is performed in a long drying tube (blowline). The dry fibre is stored in silos to await further processing.

Mat-forming

A mattress is dry-formed on caul plates. This is gradually compressed by steel belts. For thick boards, more than one mat may be piled on another.

Pressing

The dry mattress is pre-pressed to consolidate it and then cut and formed to press sizes, finally to be cured with heat and pressure in a multi-daylight press. Continuous presses are also now being used.

Trimming and sanding

After cooling, each panel is trimmed and sanded to precise dimensions.

Standards

The British and European Standards relating to fibre building boards are outlined in the Wood Information Sheets:

WIS 2/3 – 45 Fibreboards – Key Standards listing

WIS 2/3 – 46 Fibreboards – European Standards

WIS 2/3 – 47 Fibreboards – European Standards – Test methods.

General Performance Levels

The main types of fibre building board are:

Hardboards

Fibre building board with a density exceeding 900 kg/m^3 and defined minimum properties of strength and dimensional stability. Tempered hardboard has higher strength and resistance to water absorption than standard hardboard. Density usually exceeds 960 kg/m^3.

Mediumboards

These are of two types:

Low density - from 400 kg/m^3 to 560 kg/m^3.

High density - from 560 kg/m^3 to 900 kg/m^3.

Medium density fibre board (MDF)

Fibre building board made by a dry process in which the primary bond is derived from a bonding agent, density over 450 kg/m^3.

Softboard

Fibre building board with density less than 400 kg/m^3. Softboard can be modified by impregnation with bitumen and/or other moisture resistant additives during or after manufacture.

For more information or to order publications, contact the TRADA Information Centre on 01494 563091.

TRADA Technology Ltd
Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire HP14 4ND, UK
Telephone: +44 (0)1494 563091 Fax: +44 (0)1494 565487

http://www.trada.co.uk email: information@trada.co.uk