BUILDING DIGEST

CENTRAL BUILDING RESEARCH INSTITUTE INDIA

HARDBOARD AND PARTICLE BOARD

For many centuries the only type of panel material available to the building, furniture and other wood using industries was made of solid wood either in a single piece or by joining together a number of pieces. Since the beginning of this century many substitutes for solid panels have been created. Among the most important of these are plywood, blockboard, hardboard and chipboard or particle board. This Digest describes the characteristics and uses of hardboard and particle board the production of which started in India in recent years.

The chief raw material for the manufacture of these two classes of boards is wood but other woody and fibrous materials are also used. The raw material is reduced to its constituent fibres and reconstituted under heat and pressure to produce hardboard. Ordinarily no adhesive is used in hardboard manufacture, the natural lignin of the wood serving as the bonding agent. For particle board the raw material cut into tiny pieces is bonded into a cohesive matrix at high temperature and pressure using an adhesive. In both classes of boards the grain of the wood is destroyed and with it the anisotropy of wood.

Because of their basic similarity hardboard and particle board have many common properties. Both are homogeneous over large areas without the knots and other defects that are found in natural wood. The absence of grain gives to the boards equal strength in all directions along the surface.

Hardboard

The differences in the structure and composition of hardboard and particle board are responsible for the differences in their characteristics. Normal hardboard consists wholly of wood fibre except for a very small proportion of water repellent. It is in general denser than particle board and is produced in thin sheets. Thicknesses greater than 10 mm are unusual.

Normal hardboard subjected to a heat treatment after the addition of a material such as a drying oil or a synthetic resin is known as tempered hardboard. Baking stabilizes the additive and provides extra strength, stiffness and water resistance to the board.

Hardboard may be manufactured with either one or both sides smooth. Boards smooth on one side are designated S1S. They have a screen pattern on one side that is produced when the wood fibre mat is pressed along with a wire screen between press platens during manufacture. S2S board is smooth on both sides. The grade now manufactured in India contains a resin additive.

Particle Board

Particle board is made from chips or flakes of wood or similar raw material, These particles are larger than the fibres in hardboard. They usually have a definite geometry that can be changed to provide different properties in the finished board. Except in the very dense products, the size and shape of the particles are apparent in the finished board. A synthetic resin adhesive such as urea-formaldehyde resin or phenolic resin is used to bind the particles. A small proportion of water repellent is also added. These additives are mixed with the particles and the mixture is formed into mats and cured under heat and pressure. The properties of the finished board are largely determined by the nature of the binder and the curing conditions. Particle board is generally less dense than hardboard but is produced in greater thicknesses. Usual thicknesses are more than 10 mm.

Particle board may be homogeneous throughout or it may have a layered cross section. In the layered structure, coarser particles, usually with a lower proportion of adhesive, form the core of the board and finer particles the surfaces. The fine particles near the surface give the layered board a smoother finish.

The mixture of particles and adhesive may also be consolidated by an extrusion process but the resulting board has low flexural strength because during the process the particles get oriented along the thickness of the board. These boards are excluded from the discussion in this Digest.

A particle board requiring little or no adhesive is being developed from mature coconut husks by the C. B. R. I.

Veneered and Laminated Panels

Hardboard and particle board are used widely as core material for wood veneers, plastic laminates and other sheet materials. The good dimensional stability of particle board makes it possible to produce flawless composite panels for panelling, doors, furniture, etc. To prevent warping, the core material should have the same thickness of laminae on both sides. If the laminated panel is required to have only one decorative face, less expensive laminae of similar characteristics may be used on the back side of the panel.

Properties

Both hardboard and particle board are available in large sizes free from grain and natural defects of wood such as shakes, splits, knots, etc. The panels have nearly equal strength in all directions along the surface. Hardboard is generally more dense than particle board and its higher density confers on it higher strength and hardness. Normal hardboard, sometimes referred to as standard hardboard, usually has a density of about 1000 to 1100 kg/m^3 or more. IS : 1658-1966 lays down minimum requirements for these. Fibre insulation boards, IS : 3348-1965, have a density not exceeding 400 kg/m^3 and are based on fibres similar to those used for hardboard.

Particle boards are also manufactured in different densities. The general purpose grade usually has a density or 500 to 700 kg/m³ and is comparable to medium density wood. IS : 3087-1965 lays down specifications for this grade of board and veneered panels are covered by IS : 3097-1965. Particle boards of density less than 400 kg/m³ (IS:3129-1965) are used for insulation purposes. High density particle board, 900 kg/m³ and above, are also manufactured for special uses.

All wood based panel products are hygroscopic and change their dimensions due to seasonal changes in humidity. However, the anisotropic swelling and shrinkage characteristic of solid wood is largely neutralized in hardboard and particle board which show a surface moisture movement of about 0.25 per cent in all directions for a relative humidity change from 30 to 90 per cent. The corresponding movement in thickness is 4 to 5 per cent. The homogeneous nature of the boards results in uniform moisture changes over their whole surface. This uniformity in behaviour reduces the tendency for warping. Of all the common panel products derived from wood, particle boards are the least susceptible to warping. Since the mechanical properties of hardboard and particle board are highly influenced by air humidity the boards should not be used as stress-bearing elements subjected to long duration loads, especially in regions of high humidity.

Hardboard and particle board are susceptible to decay unless protected by preservatives. There is some evidence that particle board bonded with phenolic resin adhesive has greater durability than urea resin bonded board. However, neither type can be expected to last long in exterior locations. Wood based boards are inflammable but the denser boards ignite less readily.

Fabrication and Working

Hardboard and particle board can be worked with standard woodworking tools. They can be sawed, routed, rabbeted, shaped and drilled. The homogeneity of the boards and the absence of grain make it easier to work with them then with most medium density natural woods. Good edges and sharp corners are easy to obtain provided sharp tools are employed. Because of the higher density of most hardboards and the presence, in particle board, of a synthetic resin adhesive which is somewhat abrasive, normal wood working tools will require more frequent sharpening. For this reason carbide tipped saws and cutters are recommended on production runs. Sharp tools are important in working the boards. Torn or ragged edges are usually the result of a dull tool. Feed head should be moderate and tool rotation speeds high.

Hardboards have considerable flexibility and may be bent to a fairly small radius of curvature. If the bends are to be permanently supported in use the boards may be bent and fixed in the dry condition. For bends that will not be supported, the board should be wet. It may be submerged in warm water for 30 minutes to several hours depending on the type and thickness of board. S1S board may be soaked by scrubbing water into the screen side.

The absence of grain makes it possible to nail or screw the board close to the edges without splitting. Pilot holes should be drilled before driving screws. Ordinary screws are adequate. The holding power of screws driven into the edges of particle board is less than for natural wood. Screws of about 20 per cent greater length than for wood is, therefore, recommended for use on edges of particle board. A fresh coat of an adhesive improves the holding power of screws and nails. When large particle board panels are used in locations where they are subject to much movement and vibration as in doors, screw fasteners may work loose in course of time. The use of edge strips of wood on the panels is recommended in such situations.

Particle boards, especially the three-layer variety, and veneered and laminated boards of all kinds should not be cut asymmetrically unless a symmetrical joint is to be produced with it. Asymmetrical cutting may lead to warping and loss of strength because the strength of the board is derived from all the layers and is balanced.

Finishing

Particle board may be painted, varnished, polished or printed. Filling is generally necessary. Conventional finishing methods are suitable. Edges should be heavily sealed before painting. However, if moisture gains access to the board, swelling in thickness will cause rupture of paint film on edges. It is good practice to paint both sides of particle board to eliminate chances of warping due to unbalanced absorption of moisture. Almost any kind of finishing material may be used on hardboard and particle board. However, varnishes and varnish stains should not be used as first coat on hardboard. Because of its high density hardboard needs no filler.

Uses

Hardboard and particle board are used in furniture manufacture and in buildings as doors, panelling, partitions and ceilings. Particle boards have limited use also as shuttering material. Hardboards are used to a considerable extent in temperate climates as cladding and roofing material for buildings where appearance is not of prime importance. There is evidence that both hardboard and particle board can be put to similar uses in India provided the boards are first given a waterproof and weatherproof coating For this purpose, the C. B. R. I. has developed a cashewnut shell liquid plastic coating of outstanding weather resistance.

There is a demand for short notes summarising available information on selected building topics for the use of Engineers and Architects in India. To meet the need this Institute is bringing out a series of Building Digests from time to time and the present one is the 44th in the series. Readers are requested to send to the Institute their experience of adopting the suggestions given in this Digest.

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