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BUILDING RESEARCH NOTE

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CENTRAL BUILDING RESEARCH INSTITUTE, INDIA

PARTICLE BOARD AND ITS USE IN BUILDINGS

Particle board is a wood-based panel product which provides a surface of greater length and cross section. It consists essentially of wood particles of suitable size and resin binder. It is thus different from the conventional fibre board which does not contain any organic binder. For its preparation, wood is first converted into small particles, dried to a fixed moisture content say 8% and then graded to required particle size. Graded particles are next blended with the requisite amount of sythetic resin adhesive and paraffine wax emulsion, consolidated and formed into a mat of required thickness and pressed under platten type hot press. The resin blended wood particles may also be extruded into flat sheets of required thickness and density. A suitable preservative and fire-retardant composition may be added if required to the mix while blending wood particles with resin adhesive.

Particle boards may be classified according to :

A– Density

(1) Low density board; 400kg/m³
(2) Medium density board; 500–800kg/m³
(3) High density board; 900 kg and over/m³

B– Type of Resin Binder

(1) Boiling water resistant (BWR). Grade A and Grade B
(2) Warm and cold water resistant (WRandCWR) Grade A and Grade B

C– Arrangement of Wood Particles and Distribution of Resin.

(1) Three layered board.
(2) Non-layered board.
(3) Graded board.

The particle boards may also be veneered with decorative veneer.

They maintain the colour, warmth and appearance of wood. They do not exhibit anisotropic behaviour of wood in their swelling and shrinkage, with change in moisture content. Particle boards bonded with phenol-formaldehyde resin (BWR) are suitable for use in exterior situations, whereas urea formalde hyde bonded (CWR) boards are suitable only for interior use.

The properties of a particle board depend primarily on the size, shape and species of wood particles, quantity and distribution of resin binder and its bond with the particles, density of the board and other processing variables. An increase in the resin content helps in improving its durability and other physical properties. Normal particle boards have densities equivalent to wood.

Particle boards are available in different sizes. It presents a uniform and smooth surface and can be cut and nailed. All these properties make it an ideal material for many interior applications in building. It is, however, greately affected by moisture, which damages particle-to-particle bonds and particle-to glue bonds. In exposed situations, it shows swelling, popping of wood particles, surface erosion, delamination and edge cracking. On these accounts the use of particle board in building has rather been very limited in India. Lack of in-service performance data on this material may be another reason for its restricted application. Considering these factors a systematic investigation on the use of particle boards, including fibre boards as cladding and roofing unit, was undertaken at this Institute a

few years ago. First part of the investigation consisted of outdoor exposure of untreated particle boards and fibre boards. Following conclusions were drawn after two years outdoor weathering.

(1) The boards showed severe surface erosion, swelling, edge cracking and fungus growth.

(2) Three layered particle board suffered from delamination. Outer layers separated from the core. Non layer board did not fail in this aspect.

(3) The boards became weak and lost considerable bending strength (more than 50%) and nail holding properties.

Most of the deterioration may be attributed to its poor water resistant properties and since untreated boards are seldom used outdoors, the above observations give only an indication of the probable failures of the material in service. A number of small structures were, therefore, put up giving due consideration to spacing of the support, size and spacing of screws/nails etc. The external surfaces of the boards were given three coats paint-system viz, pink primer, synthetic enamel undercoating and finishing (IS : 2932-1970). Many other small structures were mostly of non-layer board which were treated with (CNSL) resin coating extended with iron oxide red. A section of the roof was given a three coat paint system after sealing it with a coat of CNSL resin.

The paint-system consisting of pink primer and synthetic enamel failed in two years. South-east wall showed exsessive cracking and peeling of the paint film. The Board suffered from fungus growth subsequently. Nail heads opened up. The exposed edges of the boards failed due to swelling and cracking in less than two years. A coat of synthetic enamel was applied at this stage and observations were then recorded again after a period of two years. South-east facing board lost its strength considerably. Change in density, water abosorption, swelling and modulus of rupture before and after weathering are given in table 1. The ground joints failed on account of excessive swelling and

Table 1

Properties of the Particle Board Sample Taken from the Wall of the Standing Structure

Property	New Sample	After 4 years outside exposure
1. Density, kg/m³	765	630
2. Modulus of rupture, kg/cm²	172	98
3. Water absorption, 24 hr., per cent	52	79
4. Swelling. per cent (Standing Structure)	—	12
5. Swelling, per cent (24 hr. water immersion)	8.7	12+12=24

disintegration of wood particles. At many places the board gave way at its lower ends. The horizontal joints and wood beadings did more harm than good to control swelling of the edges. They obstructed free flow of rain water, which led to swelling, softening and disintegration of the board. Particle board roofs remained in good codition at the end of five years exposure. CNSL coating remained in good condition. Swelling and edge cracking remained confined to the ends only. Black stains and fungus growth appeared on the underside of the board at isolated places where the water could permeate through the board.

The structures remained in good condition when the boards were generously treated with CNSL resin and regularly received a coat of synthetic enamel after every twelve months.

The condition of hard board used as walling material remained quite satisfactory even after 4 years. The paint has, however, failed due to loss of adhesion and excessive peeling of the film. Exposed edges covered by beadings at the ground level failed due to swelling and disintegration. Hardboards treated with CNSL resin did not fail when used as roofing units during the same period.

From the observations given above it is clear that most of the failures are attributed to water soaking by the board. Volume expansion of wood particles fotces out any paint film on it. The paint can at best delay moisture penetration but can not stop it. A regular maintenance painting can, therefore, improve its effectiveness. The situation can, however, be very much improved by water-proofing the board. Normally 1 to 1.5% paraffin wax emulsion is blended with the particles, which appears inadequate. At the same time addition of more paraffin wax does not yield any advantage either. Cashewnut shell liquid resin protects the board by virtue of its being highly resistant to water and excellent outdoor durability. Soaking the resin into the board appears more effective than the coating. The impregnation of P.F. resin has also been reported to produce greater dimensional stability than the percentage of resin applied entirely as binding resin. The use of graded particle board for exterior application promises greater durability. Fine wood particles on the surface of the board will not only prevent defects arising out of particles swelling under the influence of moisture but will also reduce paint consumption.

Swelling of particle board has a serious deteriorating effect on its mechanical properties. Its prevention by painting or providing wood beading around it is inadequate. The best solution is water proofing the open ends, which must protect it against water getting through it.

Conclusions

From rhe discussions given above the following conclusions may be drawn :

1. Particle boards and hard boards can be used as roofing and cladding units, if they are properly treated with CNSL resin. A life ol more than ten years can be expected from such a material.

2. Alkyd or oil based paints do not protect the board for more than two years.

3. Proper sealing and proofing of the edges and vertical and horizontal joints ensure greater durability of the structuie. Covering the ends with beading should be finished at an angle to permit rapid shedding of water.

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