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Particle Boards from Coconut Husk

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Particle boards of attractive appearance, good strength and satisfactory resistance to decay and fire have been prepared from the unretted husk of mature coconuts. The proportion of synthetic resin binder required for their preparation is only 0·5 per cent compared to 6-10 per cent required in the conventional manufacturing process. The cost of production of one sq. m. of board of density 640 kg./cu. m. and 1·9 cm. thickness is estimated to be Rs 3·11 as against the wholesale price of Rs 8·3-Rs 10·5 in UK. The boards may find potential application for partitions, ceilings and cheap roofings for buildings.

INDIA is one of the largest coconut growing countries, with an annual production of about 3000 million nuts. About half the quantity of husks obtained from these nuts is utilized by the coir industry while the other half does not find any industrial use at present. It has been reported that coconut husks can be processed to produce building boards of many kinds[1-4]. Even if only 10 per cent of the husk which is not being industrially utilized were to be converted into particle boards, the production would be about 3·7 million sq. m. (40 million sq. ft) of board of 1·9 cm. ($\frac{3}{4}$ in.) thickness and 640 kg./cu. m. (40 lb./cu. ft) density. The investigations reported here have shown that particle boards possessing attractive appearance, good strength and satisfactory resistance to decay and fire could be prepared at a low cost from the unretted husks of mature coconuts. The boards are suitable for use as partitions, ceilings and cheap roofings in buildings. Husks for board manufacture could be collected in the same manner as for retting and coir manufacture.

Chipping the husks

Dry husks of mature coconuts were cut into pieces about 5 cm. long on a circular saw. The cut pieces were then beaten by a wooden mallet and shredded by hand into thin fibre bundles. Most of the pith present in the husk remained attached to the fibres during this process. A commercial wood chipping machine was also tried for chipping the husks, but the fibres proved too tough for the machine and satisfactory chips were not obtained. A chipping machine specially designed for this purpose would be necessary for large scale production.

Application of adhesive

Adhesive is the costliest item in the manufacture of particle boards, 6-10 per cent of it being normally employed for the purpose. But coconut husk particles develop adhesion under heat and pressure and boards could be prepared without using any adhesive. However, it has been found that the use of about 0·5 per cent of phenol-formaldehyde resin adhesive by weight of the chips increases the water resistance of the boards and also their strength. An aqueous dispersion of the adhesive[5] was applied uniformly by spraying it into a revolving drum containing the chips.

Pressing

After the application of the adhesive, the chips were spread as an even layer in a mould (122 × 107 cm.) and consolidated into a mat by cold pressing. The mat was loaded into a hot press and pressed at 150°C. and 10 kg./sq. cm. for 25 min. for obtaining 1·9 cm. thick boards. The different stages

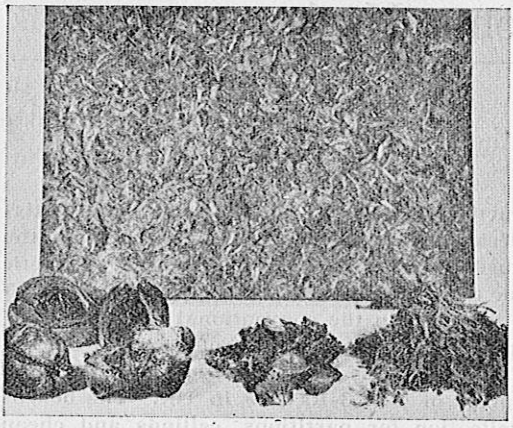

FIG. 1 — DIFFERENT STAGES IN THE PREPARATION OF PARTICLE BOARD FROM COCONUT HUSK [The husks (foreground left) are cut into short lengths (middle) and converted into chips (right) before being consolidated into a board (background)]

in the preparation of the board are shown in Fig. 1.

Results

After a week's storage at room temperature, the boards were tested for flexural strength, water absorption, equilibrium moisture content at different relative humidities, thermal conductivity and fire resistance.

The boards prepared were of 1·9 cm. thickness and had density of 513 kg./cu. m. (32 lb./cu. ft). The flexural strength of boards, determined according to B.S. No. 690 but without prior immersion in water was 138 kg. compared to an average minimum value of 107 kg. required for 0·95 cm. thick flat asbestos cement sheets. The water absorption on complete immersion of 5 × 5 cm. specimens for 24 hr was 151 per cent. The value could be brought down by incorporating a small proportion of paraffin wax in the boards as in the usual commercial practice. The equilibrium moisture content values in the present case at 25°C. ranged from 5·9 to 19·4 per cent as the relative humidity is increased from 31 to 93 per cent. The values are considerably lower than those reported for coconut husk[4]: for example, the moisture content of the board is 8·1 per cent at a relative humidity of 52 per cent as against the reported value of 12·5 per cent for the husk at a relative humidity of 54 per cent. This should prove valuable in the application of the boards for thermal insulation. The thermal conductivity of air-dry boards was found to be 0·608 cal./(hr) (sq. cm.) (°C. per cm.) [0·49 B.t.u./(hr) (sq. ft) (°F. per in.)]. Wood-based particle boards of density 400-800 kg./cu. m. have thermal conductivity values[6] ranging from 0·5 to 1·2 cal./(hr) (sq. cm.) (°C. per cm.).

Fig. 2 shows a burning test for comparing the resistance to fire of coconut husk particle board and the conventional commercial board. The latter burns freely while the husk board does not. This property of fire-resistance should increase the value of husk boards as a building material.

Cost

The cost of production of one sq. m. (10·76 sq. ft) of board of density 640 kg./cu. m.

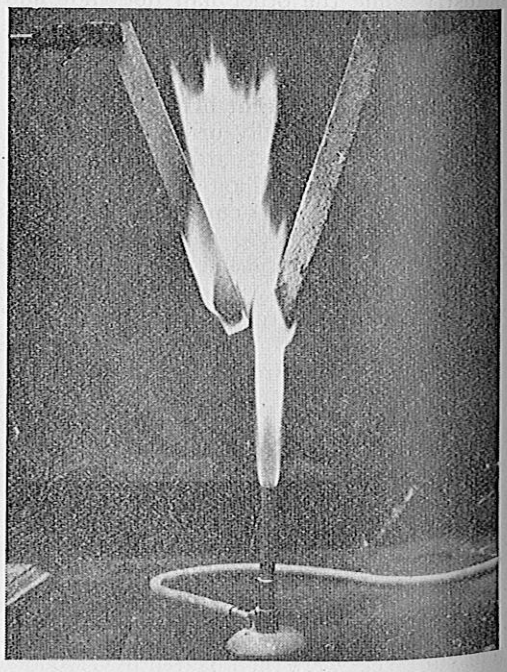

FIG. 2 — BURNING TEST FOR FIRE RESISTANCE [The flame does not spread on coconut husk board (right) while board from wood burns freely (left)]

(40 lb./cu. ft) and 1·9 cm. thickness is estimated to be Rs 3·11 or about 29 nP. per sq. ft. As against this, the wholesale price of one sq. m. of particle board of the same density and thickness ranges from about Rs 8·3 to Rs 10·5 (77-97 np. per sq. ft) in UK.

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