THERMAL INSULATION BOARDS FROM COCONUT PITH

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Processing technique and physical characteristics of thermal insulation boards prepared from coconut pith using rubber latex as the binding agent are reported in this communication. In view of the easy processing, low cost and comparable physical properties with other insulating materials availble indigenously, manufacture of these boards appears to be promising.

INTRODUCTION

Coconut pith which is obtained in large quantities as a by-product of the coir industry does not find any industrial use. With an annual production of over 3300 million nuts in our country (Leela Nayar, 1969), disposal of the waste-husk and pith poses a big problem to the industry. Possibilities of using agricultural wastes viz; arecanut husk, bagasse, wet retted pith and unretted husk of mature coconuts etc for the production of insulating wool, pads, particle boards and the like have been reported by Narayan Murthy *et al* (1947), Pillai and Warrier (1952), Iyengar *et al* (1961), Joseph George and Shivsalkar (1963). As a part of a programme on development of cheap insulating materials for use in fish industry like making of ice boxes and refrigerated fish holds, work on preparation of insulation boards out of coconut pith using rubber latex as the binding agent was carried out on a laboratory scale.

EXPERIMENTAL

Coconut pith obtained from the coastal areas was graded into coarse, medium and fine (19.5%, 24.5%, 55%) respectively and 1% refuse using sieves of openings 1.5 and 2mm. Floatation method was used to remove sand from the pith, as it had to be wetted later for uniform mixing of the binding agent. For making an experimental board of size 30x30x2.5 cm^3, 400 g of dry pith or equivalent wet pith was thoroughly mixed with 200 ml of rubber latex (60% cencentration by volume) diluted with equal volume of ammoniacal water. The mixture was then spread into a suitable wooden mould unit and 200 ml of commercial acetic acid of 50% concentration by volume were sprayed uniformly to coagulate the latex. The mixture was then pressed in a specially designed screw press at a pressure of 10-15kg/cm^2 for 2 or 3 minutes to expel the excess acid. The acetic acid coming out during pressing (which was diluted

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to 60% of original concentration) can be re-used by making upto the original concentration. The pressed board containing 60 to 65% moisture was dried in a hot air dryer at 50 to 60°C to a moisture level below 10%

Results and Discussion

The physical properties of the board prepared from medium size pith studied were (a) moisture content at different % relative humidities, (b) tensile, compressive and impact strengths, (c) rupture (bending) modulus etc and the results are reported in Tables I and II. The physical characteristics of other insulants viz; cork, foamed polystyrene and resin bonded fibre glass are also given in Table II for comparison. From Table I it could be seen that the moisture content of the board even at high relative humidities at ambient is as low as 11.3%. The pith boards having very low moisture content actually were resistant to mould growth, white ants and vermin attack and the boards did not decay during prolonged storage. Boards packed in bitumen lined kraft paper and stored at room temperaature gained 2 to 3% in moisture during six month's storage.

Table I Equilibrium Moisture Content at Different Relative Humidities (25.5° to 27°C)

% RH	Moisture content %	Thermal conductivity Kg Cal/m/hr/m²/°C (10°C - 37.8°C)
40	6.3	.031 — .033
50	7.3	—
60	7.8	—
70	9.1	—
85	11.3	.034 — .038

The thermal conductivities (K value) of the boards at mean temperatures 10° and 37.8°C were determined by Lees' and Charlton method. They varied from 0.033 to 0.039 Kg. cal / m / hr / m² / °C (K varies with density of the board and size of pith) and though it is higher than that of foamed polystyrene, compares favourably with cellulose board and resin bonded fibre glass. Iyengar *et al* (*loc cit*) have reported significant variation in thermal conductivity values despite very little change in the moisture content of the boards. Also they have reported K values increasing with decrease in mean temperatures. The K values obtained at low mean temperatures in the present experiments, however, were lower than those reported by these workers. The K values also vary slightly at different mean temperatures.

From the point of view of practical utility of coconut pith board, it has been found that it can be used for insulation purposes in the construction of fish boxes and fish holds. The boards are found to withstand temperatures between −40°C and +80°C without any apparent change in the physical characteristics or in overall efficiency. Mechanical properties like compressive and impact strength and rupture modulus compared favourably with foamed polystyrene. The only drawback of the board, however, is its permeability to water. The absorption of water can be minimised by giving a water-proof coating of polyvinyl chloride resin or Dipsanil V like compounds (Kationic emulsion of paraffin wax).

Summary

The investigations reported here, have shown that the coconut pith boards possess low thermal conductivity, good strength and comparable physical characteristics to other insulants available in the market. Further advantages are (a) availability of all raw materials locally, (b) low cost averaging 60Ps. for a board of size 30x30x2.5 cm³ and (c) simpler and quicker processing. As no costly

Table II Merits and demerits of insulating materials normally used for refrigeration purposes (Allen C. Wilson and Thermocole technical data)

Description	Cork with natural resin binder	Expanded poly styrene	Fibre glass resin bonded	Coconut pith board latex bonded
Conductivity kgcal/m/hr/m^2/°C	0.034 at 37.8°C	0.026 at 23.9°C	0.031 at 37.8°C (48 kg/m^3)	0.033 to 0.039 at 10°C to 37.8°C
Bulk density kg/m^3	128–192	16–20	16–48 (usual low temperature insulation is 32–48)	170
Compressive strength	0.37 kg/cm^2 at 5% deformation	1.17 and 1.44 kg/cm^2	Varies with density	2.4 kg/cm^2 (across)
Tensile strength	—	—	—	11.95 to 13.13 kg/sq cm
Impact strength	—	0.3 to .07 cm kg/cm^2	—	0.843 cm kg/cm^2
Flextural strength	—	3.6 to 4.3 kg/cm^2	—	3.5 to 4.2 kg/cm^2
Operational range	— 183°C to + 95°C	— 183°C to + 73°C	— 45°C to + 232°C Max	— 40°C to + 80°C.
Resistance to acids and alkalies	Not resistant	Good	Good	Not resistant
Combustibility	Burns	Melts at 150°C	Binder fails at 232°C	Burns
Advantages	Resilient, can be prefabricated, easy handling	Light weight, low conductivity, clean, easy to work	Light weight, easy to work	Resilient, easy handling, economical, raw materials indigeneously available.
Disadvantages	Requires vapour barrier	Cannot be used with hot adhesives	Requires support and vapour barrier	Requires vapour barrier.

equipment or machinery is needed, the boards can be manufactured on a cottage scale.

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