RECENT DEVELOPMENTS IN COIR PITH BASED PARTICLE BOARDS: A REVIEW

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ABSTRACT

Coir pith is produced in the separation process of the fiber from the coconut husk and is generally dumped as an agro waste. Because of its low degradation in the environment, the hillocks of coir pith collected or dumped in useful lands pause serious health hazards and loss of fertile lands. Therefore attempts are being made to convert these wastes into useful materials. This paper describes various works done on particle boards particularly using coir pith and discusses the possibility of utilising such coir pith in the context of particle board. It is reported by many authors that these coir pith boards can be used in place of wood or MDF boards for partitioning, false ceiling, surface paneling, roofing, furniture, cupboards, and wardrobes. Experimental analysis indicated that the mechanical strength such as modulus of rupture and modulus of elasticity and water resistance of the boards increased by increasing board density. Though the coir pith have been tried alone or in combination with other natural fillers for the production of particle boards, with relative success in certain properties, the amount of work done is limited compared to other agro wastes. Hence these boards are appropriate for interior use only. Jute-coir boards can be The culture and use of coconut palm and coir waste are described, and particleboard made from coir fiber and framing timber made from coconut wood were examined.

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INTRODUCTION

A large amount of agro wastes are produced annually worldwide. If left unattended, these wastes occupies fertile, useful lands and posses serious environmental and health problems like water contamination by leaching, bad odour, microbial growths etc. Generally they are burn in the field itself resulting in increased amount of green house gases. Therefore attempts are being made to convert these wastes into useful materials. Producing biofuels, alternate products such as composite materials, manures are being tried world over successfully. Developing particle boards out of these wastes has been tried world over and are being commercialized. Coir pith is a by-product extracted from coconut fiber. After the removal of fibre from the husk by natural retting or mechanical process, the coir pith is dumped outside the coir industry as a waste. Because of the high lignin content left to it self, coir pith takes decades to decompose; it only begins to break down when it is 10 years old. The dumping and increasing accumulation of coir pith each year is a increasing environmental problem. If left unattended, these wastes occupies fertile, useful lands and posses serious environmental and health problems like water contamination by leaching, bad odour, microbial growths etc. Proper use of coir pith makes it eco-friendly and biodegradable. It is very light and easy to handle. The properties of coco pith make it resistant to bacterial and fungal growth. Coir pith has a high lignin (31%) and cellulose (27%) content. Its carbon-nitrogen ratio is around 100:1. Physico-chemical composition of coir pith is as follows: Ash 8.7%, Fats and resin 1.8%, Pentosans 7.45%. Bulk density 0.2 g/cc, Calorific value 3400 kcal/Kg, Water holding capacity 460 vol%, Lignin 30-35%, Cellulose 20-25%. Organic carbon 20-25%, Nitrogen 0.3%, Phosphorous 0.01%, Calcium 0.4%, Magnesium 0.36%, Iron 0.06%, Manganese 1.3%, Zinc 0.8wt%.(Ash.B,et al.,2006). Coir pith is used as consumable fuel in boilers in some country as the calorific of coir pith is high. Also it is used in mulch and organic fertilizers in horticulture and floriculture as a soil conditioner and substitute for soil. Its water retaining capacity and compressibility besides light weight are main characteristics which make it widely applicable. And now a days coir pith is used for absorption of methylene blue (Kavitha.C, Namasiavayam.C, 2007), absorption of acid yellow 99 binding, (MotiarMd,etal.,2011) biomethanation, (Deivanai.K and R.KasturiBai, 1995), removal of uranium from aqueous solution,(M.Sudersanan,et al.,2005),removal of phosphate from aqueous solutions, (Anoop Krishnan. K, Ajit Haridas, 2008) and preparation of particle board. Particleboard is defined as a panel product manufactured from lignocellulosic materials, primarily in the form of discrete particles (T. M. Maloney, 1977). The primary

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difference between particleboard and other reconstituted wood products, such as waferboard, oriented strandboard, medium density fiberboard, and hardboard, is the material or particles used in its production. The major types of particles used to manufacture particleboard include cotton stalk, kenaf, wood shavings, flakes, wafers, chips, sawdust, strands, slivers, and wood wool. The term particleboard sometimes is used generically to include waferboard and oriented strandboard, which are manufactured primarily with wood flakes and wafers (J.G.Haygreen and J.L.Bowyer, 1989). (Ogawa, H. 1977), (Thampan, P.K. 1975, 1981), (Pablo, A.A.; Lovian, A.F. 1989), (Pablo, A.A.; Suguerra, J.B. 1977, A, B), (Pablo, A.A. et al., 1978), (Tamolang, F.N. 1976), (Chittenden, et al.,1970). (George, J. 1964), (George,J, Shirsalkar, M.N. 1963).

Though coir pith takes longer duration to degrade and is light weight and resistant to microbes and fungal growth making it an ideal material for particle boards, very less works are being done. The effect coir pith particle size and the type of resin used on the mechanical properties of coir pith/ polymer composite particle boards were analyzed (R, Viswanathan, L. Gothandapani, 1999). Coir piths of 10-15% moisture and graded to the average particle sizes of 0.45, 0.80, 1.2 and 2-1 mm were used for the experiments. Phenol-formaldehyde and urea-formaldehyde resins of liquid type with hardeners were used for the manufacturing of the particle boards and modulus of rupture, tensile strength both parallel to surface and perpendicular to surface, screw and nail-holding capacities, lateral nail-holding capacity and impact strength of the final product were determined for each board. The noise reduction coefficient of the boards varied from 0.39 to 0.54 which was not to be found to be within the usual range of medium density particle boards. The boards were found to be highly fire-resistant and tough, and possessed smooth surfaces. Another work from the same research group (George, J.Joshi, H.C. 1961), reported the use of coir fibre also along with pith resulting in enhanced bending strength. They also reported that the disk milling gives better removal of coir pith from the fibre. The authors also reported that the hard boards thus developed had low water resistance.

Narayananmurti et al., 1968, evaluated the mechanical properties of coir waste sprayed and/or mixed with various additives (such as wattle bark tannin plus formaldehyde), cold pressed followed by hot pressing for the required time. The boards were observed to have satisfactory modulus of elasticity, modulus of rupture, impact resistance, and swelling. Sampathrajan, et al., 1991, studied the thermal, mechanical and density of durian peel and coconut core mixture particle boards. The combination ratio of durian peel and coconut core (by weight) and board density were studied and were found to be dependent. Evaluation with durian or coconut-based particleboards conformed that the particleboards produced using a mixture of them have better properties, apart from the modulus of elongation, which was reduced. The novel particleboards contained a lower thermal conductivity that was found to have good application as ceiling and wall insulating material.

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analyzed with respect to board density. The mechanical strength such as modulus of elasticity and rupture were observed to be good while the dimension al stability were found to be poor.

The research group (Biswas et al., 2009, www.tifac.org.in) from Forecasting and Assessment Council, India, developed two types of composite boards for building materials as an alternate for wood products. The coir veneer boards were developed with jute face veneer and and alternate coir and rubber wood waste veneers inside. The medium density fibre board substitutes were prepared from jute face veneer and coir. A very thin layer of jute fibres impregnated with phenolic resin is overlaid as face veneer for improved aesthetics and to give a wood like finish. Since coir fibre contains 45.84% lignin as against 39% in teakwood, the coir fibre are more resistant to decaying under wet and dry conditions and has better tensile strength. Correspondingly low cellulose content in coir (43%) as against 63% cellulose in wood makes it durable than teakwood. These jute-coir boards are currently used as MDF boards for partitioning, false ceiling, surface paneling, roofing, furniture, cupboards, wardrobes etc. Fotheringham, 1981, patented a new technique for processing of coir husk based particle board. The boards were prepared by hot pressing powdered water-soaked husks at temperatures. A suitable binder was added just prior to hot pressing. The hot-press temperature was between 130°C to 165°C with a minimum pressure of 1.4 MPa and a maximum pressure of 13.8 MPa.

Particle boards prepared using combination of sawdust from pine (Pinus caribaea M.) and coconut husk or coir (Cocos nucifera L.) and portland cement at different ratios were analyzed (Erakhrumen et al., 2008). The boards were tested for dry Moduli of rupture and elasticity and density and water absorption, thickness swelling, in accordance with ASTM D 1037 (1998). The water resistance, strength properties and density measured acquired higher values in boards with high cement component but were inconsistently lowered with increased inclusion of coir in different mixing ratios. L. K. Aggarwal, 1992, investigated the use of coir for the production of cement- bonded building boards. Parameters such as fibre content and length, casting pressure and de-molding time for the production of coir-cement boards were studied in detail. Bond strength between coir fibre and cement and the physico-mechanical, thermal and fire properties of the particle boards were determined. From the investigation the developed boards were found to meet up the necessities of various standards on cement-bonded particle boards, Kochuzhathil, M.T. 1988, patented a new technique of processing of fire resistant coconut pith sheets to be used as building materials. The coir pith were mixed with copolymerizing cashew nutshell liquid and formaldehyde and hexamethylene tetramine. The mats were cold pressed for 16 hours followed by open air drying for 10 days to form a 2mm thick sheets of density 0.80 g/cm³.

References


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