



सूक्ष्म, लघु और मध्यम उद्यम मंत्रालय, भारत सरकार  
MINISTRY OF MICRO, SMALL & MEDIUM ENTERPRISES  
GOVERNMENT OF INDIA



कयर बोर्ड  
COIR BOARD



IICF  
2016

# COIR WOOD

Published on the occasion of the  
**India International Coir Fair 2016,**  
Coimbatore

**SAVE NATURE..USE COIR**

## COIR BOARD

सूक्ष्म, लघु और मध्यम उद्यम मंत्रालय, भारत सरकार  
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## Coir Wood

Save Nature Use Coir



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कलराज मिश्र  
KALRAJ MISHRA



सूक्ष्म, लघु और मध्यम उद्यम मंत्री  
भारत सरकार  
नई दिल्ली - 110011

Minister  
of  
Micro, Small & Medium Enterprises  
Government of India  
New Delhi-110011

### MESSAGE

I am happy to learn that the Coir Board, under the Ministry of MSME is organizing the 4<sup>th</sup> Edition of the **India International Coir Fair (IICF)** at CODISSIA Trade Fair Complex, Coimbatore from 15-18<sup>th</sup> July, 2016. Coir Board, during its existence spanning over six decades, has been extending dedicated services for the development of coir industry in our country. I am sure that the IICF 2016 would turn out to be an excellent opportunity to consolidate the gains so far and to equip the industry to face the challenges ahead. I hope that the compilations on coir products like Coir geotextile, coir pith, coir wood and coir floor furnishing material proposed to be released in this event would emerge as treasure of knowledge to information seekers on the industry and as a reference for posterity.

I wish IICF 2016 a grand success.

*कलराज मिश्र*  
(KALRAJ MISHRA)

एम. वेंकैया नायडु  
M. VENKAIAH NAIDU



शहरी विकास,  
आवास और शहरी गरीबी उपशमन एवं  
संसदीय कार्य मंत्री  
भारत सरकार  
MINISTER OF URBAN DEVELOPMENT,  
HOUSING & URBAN POVERTY ALLEVIATION  
AND PARLIAMENTARY AFFAIRS  
GOVERNMENT OF INDIA

28<sup>th</sup> June, 2016

#### MESSAGE

I am very happy to take note that the Coir Board, under the Ministry of Micro, Small and Medium Enterprises, is organizing the 4<sup>th</sup> edition of the India International Coir Fair (IICF) at CODISSIA Trade Fair Complex, Coimbatore from 15<sup>th</sup> to 18<sup>th</sup> July, 2016.

Coir industry in India holds its richest tradition and provides livelihood to lakhs of rural people across coconut producing regions. The industry produces wealth from waste and earns valuable foreign exchange to the exchequer. While lauding the Coir Board for its earnest commitment to promote coir industry, I convey my sincere appreciation to all those who are behind this endeavor.

I trust that the compilation on Coir Geotextiles, Coir pith, Coir Wood and Coir floor furnishing proposed to be released during this event would give complete information on application of these bio-degradable products.

I wish the IICF 2016 a grand success.

  
(M VENKAIAH NAIDU)

नितिन गडकरी  
NITIN GADKARI



मंत्री  
सडक परिवहन, राजमार्ग  
एवं पोत परिवहन  
भारत सरकार  
MINISTER OF ROAD TRANSPORT,  
HIGHWAYS AND SHIPPING  
GOVERNMENT OF INDIA

#### MESSAGE

It gives me a great pleasure that the Coir Board, under the Ministry of MSME is organising the fourth edition of the India International Coir Fair at CODISSIA Trade Fair Complex, Coimbatore from 15<sup>th</sup> to 18<sup>th</sup> July, 2016.

Coir products, by virtue of its eco-friendly and bio-degradable qualities, have tremendous possibilities for applications to preserve environment and arrest global warming. The organization of these type of activities would lead to all round and sustainable growth of the sector.

I earnestly believe that the publications on Coir Geotextiles, Coir Pith, Coir Wood and coir floor furnishings, to be released coinciding with the event, would help for a detailed understanding on the product and its application.

I wish the IICF 2016 all success.

(Nitin Gadkari)

Date: 4<sup>th</sup> July, 2016  
Place: New Delhi

सुरेश प्रभु  
**SURESH PRABHU**



रेल मंत्री  
भारत सरकार, नई दिल्ली  
**MINISTER OF RAILWAYS**  
**GOVERNMENT OF INDIA**  
**NEW DELHI**

**30 JUN 2016**

**MESSAGE**

I am happy to learn that the Coir Board is organizing the fourth edition of the India International Coir Fair at Coimbatore from 15<sup>th</sup> to 18<sup>th</sup> July, 2016.

As evident from the growing affinity world over and the steady increase in exports, Coir products have proven to be ideal for preserving the mother earth. I believe that the outcome from the event and the publications on various Coir products would be of immense prospects for the future.

I wish the event all success.

**(Suresh Prabhu)**



राधा मोहन सिंह  
RADHA MOHAN SINGH



कृषि एवं किसान कल्याण मंत्री  
भारत सरकार  
MINISTER OF AGRICULTURE  
& FARMERS WELFARE  
GOVERNMENT OF INDIA

D.O. No. 1151/AN.



New Delhi  
Dated: 30-6-2016

**MESSAGE**

I am extremely happy to note that the Coir Board, under the Ministry MSME is organizing the fourth edition of the India International Coir Fair at Coimbatore from 15<sup>th</sup> to 18<sup>th</sup> July 2016.

Being an agro based industry, the coir products have got a worldwide acceptance by virtue of its eco-friendly and bio-degradable qualities. Coir products, as I understand, have tremendous possibilities in soil conservation and agri-horti applications. I trust that organization of international events like the instant one are in the right direction to take the coir industry further forward. I have no doubt that the publications on Coir Geotextiles, Coir Pith, Coir Wood and Coir Floor Coverings, proposed to be brought out by Coir Board, would help much for a detailed understanding on the products and their applications.

**WISHING THE VERY BEST FOR IICF 2016.**

  
RADHA MOHAN SINGH



गिरिराज सिंह  
GIRIRAJ SINGH



D.O. No. 09 / MOS (MSME)/20.1.16.

राज्य मंत्री  
सूक्ष्म, लघु और मध्यम उद्यम  
भारत सरकार  
नई दिल्ली - 110011

MINISTER OF STATE  
FOR  
MICRO, SMALL & MEDIUM ENTERPRISES  
GOVERNMENT OF INDIA  
NEW DELHI-110011

**MESSAGE**

I am very much delighted to note that the Coir Board under the Ministry of MSME is organizing yet another edition of the India International Coir Fair 2016 at CODISSIA Trade Fair Complex, Coimbatore from 15<sup>th</sup> to 18<sup>th</sup> July, 2016. Coir Board has been instrumental in developing and proliferating this industry in different parts of the country. I firmly believe that the fourth edition of this event is going to add another feather to the glittering cap of Coir Board.

I firmly believe that the events would bring in more tangible results to the industry for the longer run and the publication on Coir Geotextiles, Coir, pith, Coir wood and Coir floor furnishing proposed to be released in this context will be of much use to the trade.

WITH BEST WISHES FOR IICF 2016.

(GIRIRAJ SINGH)



**HARIBHAI P. CHAUDHARY**  
**MINISTER OF STATE**  
**GOVERNMENT OF INDIA**

भारत सरकार  
सूक्ष्म, लघु और मध्यम उद्यम मंत्रालय  
उद्योग भवन, नई दिल्ली - 110011

GOVERNMENT OF INDIA  
MINISTRY OF  
MICRO, SMALL AND MEDIUM ENTERPRISES  
UDYOG BHAWAN, NEW DELHI - 110011



**MESSAGE**

I am extremely happy to note that the Coir Board, under Ministry of MSME, Government of India is all set to organize the India International Coir Fair 2016 at Codissia Trade Fair Complex, Coimbatore from 15<sup>th</sup> to 18<sup>th</sup> July, 2016. I understand that the current edition of IICF is the fourth of its kind and organized in one of the major coir producing States in our Country.

Coir products, as known to everybody, has got a tremendous product range which can even address the current day issues on global warming etc. The efforts of Coir Board to release the compilation on products like Coir Geotextiles, Coir Pith, Coir Wood and Coir Floor Coverings during this event are definitely laudable.

I wish IICF 2016 the very best and congratulate all the stakeholders of Coir Industry for venturing into this important event.

**New Delhi**

**Dated: 08.07.2016**

*Haribhai Chaudhary*

**(Haribhai P. Chaudhary)**

कृष्ण कुमार जालान  
सचिव  
**K. K. Jalan**  
Secretary



**MSME**

भारत सरकार  
सूक्ष्म, लघु और मध्यम उद्यम मंत्रालय  
उद्योग भवन, रफी मार्ग, नई दिल्ली-110 011

GOVERNMENT OF INDIA  
MINISTRY OF MICRO, SMALL AND MEDIUM ENTERPRISES  
UDYOG BHAWAN, RAFI MARG, NEW DELHI-110 011



### MESSAGE

It is indeed a pleasure to note that the Coir Board under the Ministry of Micro, Small and Medium Enterprises, Government of India, is organising yet another edition of the India International Coir Fair at CODISSIA Trade Fair Complex, Coimbatore, Tamil Nadu.

Coir Industry, as I understand, has tremendous prospects to grow and develop in our country. I am confident that organisation of these type of event, followed by actual field level interventions would bring in incremental benefits to all the stake holders and sustainability to the coir sector for the longer run. I trust that compilations on products like Coir Geotextiles, Coir Pith, Coir Wood and Coir Floor Furnishings, proposed to be brought out during this event, would help to a greater deal in better understanding of the products and its varied end uses.

I wish IICF 2016 all success.

  
(K. K. Jalan)

New Delhi,  
11<sup>th</sup> July 2016.

## FOREWORD



Coir Wood is a latest addition to the array of new generation products in coir industry. The Bureau of Indian Standards, Indian Railways, DGS&D, CPWD and Road Transport Corporation have approved the Coir Wood. The efforts for inclusion of Coir Wood in the manuals of CPWD/PWD for building construction are in progress. Coir Wood is widely used as a packaging material for the transportation of fragile materials. Five standards of coir felt have been published by the BIS based on the draft submitted by Coir Board.

The future of the world largely depends on innovative eco friendly consumer acceptable products. Coir Wood has emerged to be an ideal choice for the users especially in the building and furnishing sector. The demand for Coir Wood from the sunrise building sector would definitely pick up and this product would be the ideal choice as a wood substitute which ultimately lead to the conservation of the tropical forests from depletion. The Coir Wood has the inherent strength to keep the challenges, posed by climatic changes, at bay.

Coir Board under the Ministry of MSME is always attempting for the commercialization of new products and coir processing technologies through appropriate means and I feel that IICF 2016 is the right occasion to publish this compilation.

The continuous un relented support and encouragement received from the Hon'ble Prime Minister, Hon'ble Minister of MSME and the Hon'ble Minister of State for MSME is acknowledged with sincere gratitude. I expect the same level of support in future for bringing about sustainable growth in the Indian coir sector.

I have full faith that this compilation on Coir Wood brought out by Coir Board would be a reliable source of information for extensive use of the product.

I take this opportunity to congratulate all those who were behind this endeavour.

A handwritten signature in green ink, appearing to read 'Radhakrishnan', written over a light blue horizontal line.

C.P. Radhakrishnan, Ex . M.P.  
Chairman, Coir Board

## PREFACE

The coir wood, the new entrant to the end uses of coir is a prospective wood substitute. It is a very much eco-friendly material suitable for building and furniture sector. The combination of coir with resin and subsequent processing shall definitely preserve the natural forests and saves the trees from cutting for wood.

The coir wood is a very good value added product from coir fibre which shall increase the rural employment opportunities and also promotes agriculture leading to sustainable development. The special characteristics of coir wood have really improved its use in building construction and needs to be encouraged.

Coir is long lasting, eco friendly and leads to pollution free environment and is a renewable material and boon to the consumers as it is bio degradable. As a citizen of India, it is our prime duty to support the coir which is a traditional cottage industry and livelihood of the rural women coir artisans in bettering their earnings. The coir fibre after de husking of coconut is generating employment to the rural women coir artisans.

The coir industry is strengthening day by day which has been achieved due to the cumulative hard work of the exporters, workers and industrialists including promotional bodies like the Coir Board. It is a fact that the demand for handloom coir mattings has decreased through these years but with the advent of coir wood, the demand for handloom coir mattings may increase .It is our responsibility not to encourage and support the export of coir fibre in its raw form but export after converting in to value added products for generating employment and revenue from it.

We pray that every one shall look at the problems in a unique way for the future of coir so that we may able to bring back the golden days of coir industry. It is a humble beginning from us to publish a book exclusively for coir wood that may help even a layman to understand the technology of processing. We are sure that it will help to manufacture quality good coir products meeting the requirements and taste of consumers properly.

We sincerely expect that this publication is in the right direction and thank the guidance and inspiration extended to us by Shri C.P. Radhakrishnan, Ex.M.P., Chairman , Coir Board to compile this book in time. It is happy to place on record our sincere thanks to the continuous advice and support of Shri M Kumara Raja, Secretary, Coir Board which was crucial for completing this publication on schedule. We are highly grateful to the enthusiasm and advice from Shri P.R.Ajithkumar, Director (Marketing), Dr.Anita Das Raveendranath, Director, RDTE and T.A.Rajendra Babu,Joint Director(Res) in shaping this book in a better way. Lastly it is our duty to thank the supporting staff for their tireless, selfless and silent hard work in designing and bringing this book in to a reality.

We once again acknowledge with our sincere thanks and gratitude to the efforts of all behind this publication.

**R.Vasudev**  
Joint Director (Tech.) CICT, Bangalore



# DIRECTOR'S MESSAGE



The India International Coir Fair 2016 has been organized by Coir Board to demonstrate and disseminate to public the findings of research on coir conducted at Central Coir research Institute (CCRI) and Central Institute of Coir Technology (CICT) and through In-house / collaborative projects with reputed organizations in India. The theme for the IICF-2016 envisages sustainable development of the grass root workers in the Coir Industry and expands to overseas niche markets for coir/coir products through futuristic technologies. We are currently facing dramatic economic and market changes surrounding our business enterprises. In these circumstances, R&D becomes increasingly important in order to overcome this unprecedented transition stage and to succeed in expanding globally. The ability to predict market needs, select and focus on research themes, keep relevant divisions working together as a team, and operate with flexibility and speed is important.

Recently, much emphasis has been given worldwide to the use of biomass for different end uses due to fast depletion of fossil fuels. Coir fibre produced in abundance as a by-product in the coconut industry which has immense potential for use in the manufacture of structural composites as a replacement of wood. Through this book, an effort has been made to provide information about coir composites and its products for eco-friendly buildings. Grateful acknowledgements are due to Shri. C.P. Radhakrishnan, Chairman, Coir Board for his continued guidance and valuable support. I hope the information being delivered through this book will be helpful to entrepreneurs, researchers and for all in the coir industry.

**Dr. Das Anita Ravindranath**  
Director, RDTE, CCRI

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## COIR WOOD

### 1. Coir – the future

The future of coir industry depends on the non-traditional areas and nonconventional products. The ability to adapt itself quickly to the fast changing consumer preferences and widening choices will have a bearing on the survival of coir industry. Whether for domestic or for export purposes, the coir sector has to bring about innovative product lines keeping in mind the quality aspect of products and services so as to ensure a sustainable market potential.

Though many initiatives are being taken to revive the coir industry, the problem of inadequate R&D effort for product development and diversification is really affecting the growth of the coir industry today. In spite of the excitement over rising demand for eco-friendly products, goods manufactured out of natural fibres especially of hard fibres are finding it tough in the market day by day. The properties of natural hard fibres like inconsistency of quality, mechanical behaviors, moisture related characteristics, durability etc. are disadvantageous for large-scale industrial production. The processing technologies require specific adaptations and modifications.

The future of coir industry mainly lies in the creation of new eco-friendly and trendy, coir based building and furnishing products. The trends in the market is visibly changing, the industry may bring in immediate changes and efforts to tackle this situation. The proper management of the situation will alone ensure the sustainable development of the industry.

### 2. Wood Substitutes and Wood Panel Industry in India

Wood panel industry has a huge footing in Indian market. There is an enormous demand for wood panel products in India. Wood panel based products help in saving a considerable amount of scarce wood when compared to solid timber products. The basic types of wood based panels are

- Plywood
- Particleboard
- Medium Density Fibre board

Because of their versatility in application and efficiency in wood raw material utilization, the wood panel products have, to a great extent replaced solid wood in both structural and non-structural uses.

#### 2.1 Plywood

Plywood industry is an old industry in India. Tea industry has played an important role in developing plywood industry in India. Plywood has been the preferred raw material for making packaging materials.

In early 1950's the industry started to diversify its products and block boards, flush doors, commercial plywood, decorative plywood, marine and aircraft plywood, produced in Indian factories came into the market which were second to none in the world in quality.

The potentialities of the industry can be derived from the many uses to which plywood can be put.

## **2.2 Particle Board**

Particle board is a reconstituted constructional panel particularly developed as a substitute for natural constructional wood and is made from low-grade waste woods or from certain agricultural ligneous wastes. In this respect particle board assumes great importance in the wood panel products industry from the point of view of conservation of scarce forest resources. There are at present more than 12 wood based and agriculture lignose waste based particle board units in India.

## **2.3 Medium Density Fibre Board (MDF)**

Fibre board is a board encompassing sheet materials of widely varying densities manufactured from refined or partially refined wood fibres or other vegetable fibres. Bonding agents and other materials may be incorporated in the manufacturing process to increase strength, resistance to moisture, fire or decay. The product has taken up an important position in the construction and furniture industry across the country.

## **3. Building materials from Coconut Palm**

Given coir's close resemblance to wood in its chemical composition and the availability of renewable fibre every 45-60 days, it would be a good replacement for tropical timber. The increased use of coir composite as alternatives for forest timber, plastics, asbestos etc. encourage sustainable development

The coconut shells are used mainly as fuel, activated carbon and shell flour. It was reported that coconut shells were used in building construction either as a primarily structural material or as a filter material. It is also used beneath the ground floors in predominantly water-logged areas in order to resist the up thrust due to water pressure and incorporated in roof weathering cores to increase thermal insulation. The coir pith is used for producing hard boards, thermal insulant slabs and bricks.

The coconut wood has been used for roofing components like rafters, beams, joints, purlins. Compared with conventional furniture timbers, coconut wood, because of its abrasive nature, has less desirable working qualities. Coconut stem wood does not suffer from degrading defects such as knots. This could facilitate stem bending and use of curved profiles. Coconut stems are ideally suitable as natural round timber because the strongest wood is in outside surface of the stem.

For purposes like rural houses, temporary sheds, cowsheds, workshop buildings, farm buildings, small and rural buildings, where some wood in unfinished form could be used, coconut wood is the most suitable material cost wise.

Only the first 8 to 10 metre of the mature and over matured trees will be worth sawing. About 0.15 to 0.2 m<sup>3</sup> of sawn sizes will be available from an average size of mature tree.

## **4. Coir Wood Composites**

Coir wood composites, the new entrants, could become the sunrise sector of the coir industry. Coir wood made from coir fibre and resin has diversified new uses that will save the tropical forests, increases rural employment opportunities and also promotes agriculture leading to sustainable development.

Coir composite board has to compete with these wood panel industry's products for a place in the market. There are many factors that go for and against coir composite board. The advantages score, much above the negatives in the long run. It can be judged from the market information that coir composite board has a bright future ahead.

Bio-based resources have played a major role through out human history. Bio-based resources like coir and allied fibres are renewable, widely distributed, available locally, moldable, anisotropic, hygroscopic, recyclable, versatile, non-abrasive, porous, visco elastic, easily available in many forms, biodegradable, combustible, compostable and reactive. Bio based fibres have a high aspect ratio, high strength to weight ratio, relatively low in energy conversion and have good sound and thermal insulation properties.

A composite material is a material where two or more materials are present out of which some load bearing members and the others are for holding the load bearing members in proper orientation. Coir wood composites belong to the fibre reinforced plastics.

In the fibre-reinforced plastics, the fibres are embedded in a polymer matrix so that the former form a discontinuous phase in the continuous phase of the latter. The resinous matrix



in the material used to envelop the reinforcement. The compound materials are superior to conventional metallic materials, wood and timber, are mainly used in civil engineering, building and constructions, chemical, transportation, marine and off- shore engineering and sports good applications.

The composite material has different properties from their constituents alone. Coir wood composites can be made using coir as reinforcing material with or without plantation timber (Veneers like rubber veneer, bamboo, jute, glass) in between as a secondary reinforcement and then impregnated with polymeric matrix material like phenolic, polyester, epoxy etc. and processed under controlled temperature and pressure.



The primary advantage of the coir wood composites is due to the coir, which is natural, eco-friendly and abundantly available material. Coir is very strong due to its high content of crystalline alpha cellulose (40%) and highly resistance to borer, termite, water and other natural elements due to high lignin content (45%). The coir fibre being very strong and flexible, it can easily replace the glass fibre or can be hybridised in required ratio with the glass fibre.

The coir reinforcement fibre could be of coir felt, coir rope or coir sliver etc. Additional reinforcement fibres such as glass, bamboo, and jute fibre could also be used for improving the structural performance. The resultant coir fibre composites offer several advantages such as light weight, high strength and stiffness, non-corrosive, water resistant, long durability, low cost etc. Coir composites are highly suitable for building and construction for door, furniture and other joinery work and transportation application for cost effective replacement to wood and timber. The country is facing major environment problems due to the reduction of the forest cover.

### **4.1. Coir Wood Composites Preserve Natural Tropical Forests**

For centuries man was dependent on forests for his requirements of timber. Giant trees that have lived through several generations were cut down from the forests to meet the needs of mankind at different points in time. With each passing day, the rate of depletion of forest resources has become more and more alarming. The alarming rate at which the forest cover in the world is depleting has raised serious concern of the impact on world climatic conditions. Fears and concerns on global warming have been expressed from several quarters as 15 million hectares of forest cover gets depleted each year and in India it is estimated that on an average about 45000 acres of tropical forest being cleared every year and the Honorable Supreme Court of India has in a recent judgment, banned felling of trees from natural forests to conserve tropical evergreen forests.

The Tropical Forests have a special role in the conservation of biodiversity which shelter 70 % of the world's plants and animals. It, invariably, influenced the local and global climates. Forests absorb atmospheric carbon and replenish the oxygen in the air we breathe. Forests regulate stream flows by intercepting rainfall, absorbing the water into the underlying soil and gradually releasing it into the streams and rivers of its watershed. Tree roots enhance soil porosity, reduce compaction and facilitate infiltration. They not only meet the economic needs for food and shelter but the forest also forms an integral part of the culture and spiritual traditions of native people who rely on the forests for their way of life. Forests also give a wide range of non-timber forest products such as fibres, resins, latex, fruits, traditional medicines and foodstuffs.

The major available replacement for wood products is plastic, metals and few other products. Coir, a byproduct of coconut and therefore, considered as an eco-friendly alternative to natural forest based timber. The coir wood can substitute logs and fuel wood, otherwise exploited from natural forests. The economically available volume of coir and its utilization therefore can reduce the pressure on natural tropical forests and contribute towards biodiversity conservation.

### **4.2. Importance of Coir wood as Wood Substitutes**

One unit of coir ply with a production capacity of 40 cubic metres a day would be able to save about 22 trees per day which means 6,600 trees per year. Assuming that one

such tree requires 40 sq.metre, then it would be 25 trees in one acre so that a coir ply unit could save about 264 acres of tropical forest in every year. If 10 % of coir fibre produced is utilized in the manufacture of coir ply, it would save about 8, 80,000 tropical trees per year which corresponds to 8,800 acres of tropical forests per year.

A tropical tree, which is 90 years old, would achieve a height of 15 metres with 0.5 meters width and 0.5 meters depth gives about 3.75 cubic meters of lumber. Timber recovery at 60% would yield about 2.25 meters of planks and sheets. When converted in to a finished product there is a further wastage of 20%. Hence the total recovery would only be about 1.80 cubic metres.



**HIGH DENSITY BOARD**

**TRAY**

**ROOFING SHEET**

Coir wood made from coir fibre and phenol formaldehyde resin is an innovative wood substitute. It is a composite board and other hard fibres such as sisal and jute etc. and pre-treated plantation rubber wood veneers could be incorporated. The diversified new uses of coir composite will save the tropical forests, increase rural employment opportunities and also promote agriculture leading to sustainable development.

## 5. Coir Needled Felt

It is a non-woven fabric made from decorticated coir fibre. In the manufacturing process, well cleaned coir fibre of good staple length passes through the cleaning machines by pneumatic suction and is needled by the needle loom on one side to evolve felts of different density, punching intensity, needle penetration and thickness. The fibre is mechanically bonded (interlocked) to form a continuous length of sheet. No bonding material is used in the manufacture of coir needled felt. It can be manufactured in thickness from 10 mm to 20 mm with a density varying from 500 to 1500 g/sq.metre. The felt is available in the form of rolls of 4 ft. width and 25 meter length



### 5.1 Features of coir needled felt

- 1) Non-woven fabric with interlocked fibre.
- 2) Resilient product of porous structures.
- 3) Low thermal conductivity coupled with good sound absorption coefficient.

## Coir Wood

- 4) Light material, with ease of handling and application.
- 5) Low cost product made of natural fibre.

### 6. Manufacture of Coir wood

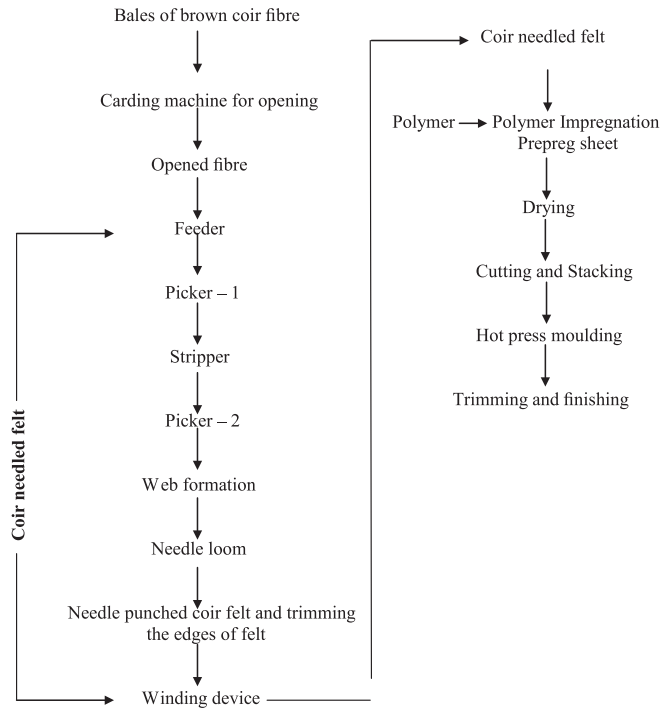


The Central Institute of Coir Technology (CICT), Coir Board has been equipped with a needled felt [non-woven] making machine that was imported from Austria costing to Rs. 1 crore. The machine has been catering to the requirements of the coir industry for exporting non-woven felts for horti/agricultural purposes. The non woven felt has been also converted into coir polymer composite boards using the phenol formaldehyde resin with which it is padded, dried and cured in the hydraulic press.

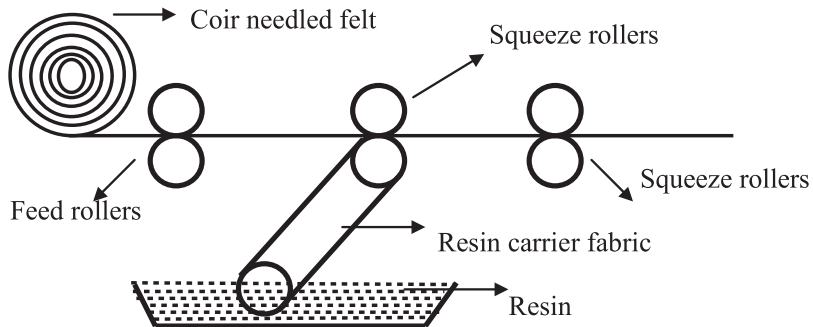


Indigenous Coir needled felt machine

## 6.1. Flow chart for manufacture of coir wood composites



## 6.2. Prepreg Sheet Resin Coating Process for Coir Wood Composite



A prepreg sheet is a polymer impregnated coir fibre mat. More than 60 % by weight of coir fibre can be incorporated in the composite by prepreg sheet moulding process. Non-woven coir needled mat is used for impregnation with resin to prepare prepreg sheets. The non-woven coir needled mat is preferred as it is more economic and the resulting prepreg can be moulded into desired shapes. The coir mat is ideal due to uniformity and ease of handling.

The incorporation of controlled amount of resin to coir needled felt is achieved by polymer impregnation process in which a resin carrier fabric is pressed against the needled

felt so that a part of the resin is transferred to the needled felt from the resin carrier fabric instantaneously. The resin up take by the needled felt is controlled mainly by the resin carrying capacity of the fabric, pressure applied on the needled felt over the fabric, speed and the properties of the resin such as viscosity and solid content. Composite products from prepreg sheets are prepared by hot press moulding. The prepreg sheet are cut into the required size and stacked one over the other. The number of layers is dependent on the requirement of thickness of the component and the pressure applied for moulding varies depending on the density and surface finish of the product. The overall mechanical strength of the fibre reinforced plastic depends on the combined effect of the amount and kind of reinforcement and on its arrangement in the finished article.

The chemical, electrical and thermal properties result from the type and formula of the resinous matrix. The cost and quality of the product depend on design and proper choice of reinforcement and matrix. Coir polymer composites' economic viability depends mainly on the amount of coir in the composite and the processing parameters like rate of production, resin content and quality control.

Trimming and polishing of the edges of mouldings and wastage of prepreg sheet can be minimised by taking care of the size of prepreg sheet used for moulding.

### **6.3. Raw Material for Coir Wood Composites**

Coir needled felt, coir matting, coir rope, resin, veneer, kraft paper, coir ply of 3mm, 4mm, 6mm, 9mm, 12mm, 16mm, 18mm, 20mm & 25mm thick are available sandwiched with wood veneer

### **6.4. Selection of Coir/Resin for Impregnation**

#### **6.4.1. Coir Needled Felt**

**Features of Coir Needled Felt** (800g/m<sup>2</sup>, 1000g/m<sup>2</sup> & 1300 mg/m<sup>2</sup>)

- Non-woven fabric with inter locked fibre.
- Resilient product of porous structures.
- Low thermal conductivity coupled with good sound absorption coefficient.
- Light material with ease of handling and application.
- Low cost product made of natural fibre.

#### **6.4.2. Selection of Resin for Polymer Impregnation**

- The phenolics are reactive towards ligno-cellulosics and have good bonding between the fabric and the polymer.
- Water based laminating phenolic resins for plywood is selected as the ideal resin for coir polymer composites due to viscosity and solid content.

##### **6.4.2.1. Characteristics of phenolic resins**

- Low cost
- Resistant to chemicals and heat
- Good electrical properties and



- Non-flammable

Depending on construction, coir composites can be classified into Coir ply, Flush / Panel door, Coir gypsum board, Packaging material, Coir- cement tiles, Panels and blocks, Rubberised coir etc

## 7. Coir ply

This type of coir composites is made using alternate layers of coir and rubber veneer using phenolic resol and can be used like plywood in paneling, false ceilings, partitions, furniture etc.



### 7.1. Construction of Coir ply

Top face layer: Random and oriented jute with phenolic resol on resinised paper carrier.

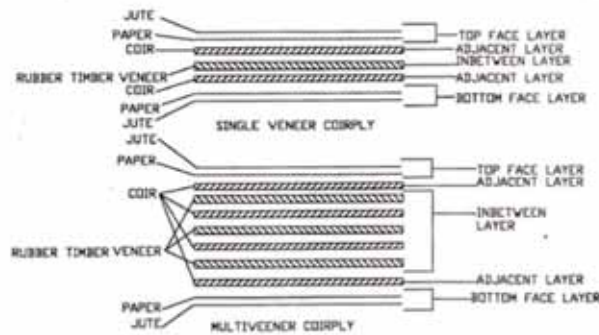


Fig. 1 - Construction of Coirply

Inner layers: Alternate layers of coir with phenolic resol (first layer being coir) and rubber timber veneer coated with phenolic resol. Total layers should be odd and minimum three.

Bottom face layer: Resinised paper carrier with random or oriented jute with phenolic resol.

### 7.2. Fabrication Process of Coir ply

Fabrication of coir felts is made in Needled felt plant. Bale opener opens the coir available in bale form. If the moisture in coir is very high it has to be dried. Then the opened coir is passed through the feeding system consisting of more openers, distributors and conveyors. The uniform coir web of required width formed by the feeding system is then needle punched with a needle-punching machine consisting of reciprocating needle board, stripper plates and base plates. The needles having bars push some of the fibres





## Coir Wood

vertically down, the fibres form loops below the web bottom surface by which the fibres are mechanically entangled. Thus a discontinuous web of coir becomes a continuous felt, which can be handled easily. After needling, the edges are trimmed and if required cuts are made by adjustable rotating cutters. Finally it is rolled by winder, which always maintains constant speed in winding in spite of continuous increase in roll diameter. When a particular length is wound, the roll is removed from the winder and core of the next roll is put. Depending on the weight per square metre, the feeding and distribution are adjusted. The density of coir needled felt can be controlled by the amount of fibre going through the needle board or by overlapping needled felts to give the desired density.

The table below gives the comparative mechanical properties of coir ply with three other materials (plywood, MDF & particle board) widely used in partitioning, paneling, cladding etc.

**Comparison of Properties of Coir Ply to Other Boards**

|   | <b>Coir-Ply</b> | <b>Plywood</b>  | <b>Medium Density Fibre Board</b> | <b>Particle Board</b> |
|---|-----------------|-----------------|-----------------------------------|-----------------------|
| Tested as per IS.No                         | IS-1734         | IS-1734         | IS-2380                           | IS-2380               |
| Density (kg/mtcu)                           | 748             | 400-+700        | 750-850                           | 700-800               |
| Moisture (%)                                | 6.50%           | 5-15%           | 5-15%                             | 5-15%                 |
| Glue shear strength (N/mm <sup>2</sup> )    | 1720            | 1200-1750       | N.A                               | N.A                   |
| Water resistance (8 hrs. boiling)           | No delamination | No delamination | Disintegrate                      | Disintegrate          |
| Tensile strength (N/ mm <sup>2</sup> )      | 23.6            | 35.55           | 7.0-8.0                           | 4.0-4.5               |
| Compressive strength (N /mm <sup>2</sup> )  | 51.02           | 29.24           | N.A                               | N.A                   |
| Modulus of elasticity (N/ mm <sup>2</sup> ) | 6440            | 3500-7400       | N.A                               | N.A                   |
| Modulus of rupture (N/ mm <sup>2</sup> )    | 47.5            | 29.49           | 25.28                             | 12.5-15.0             |
| Nail holding power (in kg)                  | 50              | 125             | N.A                               | N.A                   |
| Screw holding power (in kg.)                | 245             | 300             | 125-150                           | 85-125                |
| Surface strength (kg/ cm <sup>2</sup> )     | 30              | N.A             | 30                                | 30                    |

## 8. Natural fibre reinforced panel (NFRP)

This type of coir composite is made mainly with coir and phenolic resol. It is a substitute for Medium Density Fibre Board (MDF). These types of coir composites are made mainly with the combination of coir and jute fibres with phenolic resol. It can be used for door inserts, partitions, panelling, pelmets, furniture and numerous other applications

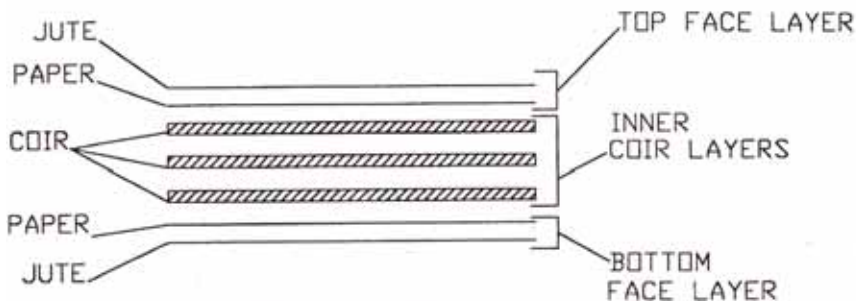


Fig. 2 - Construction of NFRP

### 8.1. Construction

Top face layer: Random or oriented jute with phenolic resol on resinised paper carrier.

Inner layer: Coir with phenolic resol.

Bottom face layer:

Resinised paper carrier with random or oriented jute with phenolic resol

For hard boards, no jute is put and face layers are of only paper with inner side coated with phenolic resol. For some flexible board, no face layers are put.



## 9. Coir Composite for Flush Door Shutter

Flush door shutter can be used to make all types of doors. It is ideally suited for bathroom and kitchen doors because it is water resistant and fire retardant.

### 9.1. Construction

Flush door shutter has been developed using

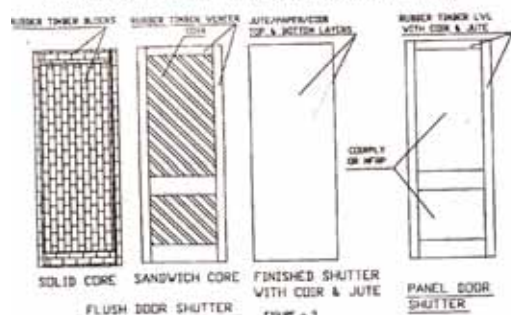


Fig. 3 - Flush Door Shutter

## Coir Wood

Top face layer: Random or oriented jute with phenolic resol on resinised paper carrier.

Inner layers

(a) Coir with phenolic resol/treated rubber timber blocks with phenolic resol coating/coir with phenolic resol.

Or

(b) Coir with phenolic resol/rubber timber frame made with veneer and filled with coir with resol/coir with phenolic resol.

Bottom face layer

Resinised paper carrier with random or oriented jute with phenolic resol.

### 9.2. Fabrication process of coir composite flush door

**(a) Solid core:** Solid core flush door with coir composite is made using chemically treated rubber timber blocks as core. The blocks are joined with corrugated nails in proper design. The core is coated with phenolic resol. On the core, inner coir layer and out side



jute face layers (random or oriented) are put. The assembly with BOPP (Bi-directional Oriented Polypropylene) release film cured between plates under required temperature and pressure in hot platen hydraulic press. It is cooled under pressure in cooling press and trimmed to size. Stacking under pressure does moisturisation.

#### **(b) Sandwich core**

Sandwich core is made with coir. An assembly is made where the styles and rails are built up with resin coated rubber timber veneers, inside gaps are filled with cut pieces of

resinised coir felt, whole thing is covered with inner core layers and outside jute face layers (random or oriented) are put.

## 10. Coir wood for Panel Door Shutters

### Construction

**Frame:** Frame is made with CLVL (Coir Laminated Veneer Lumber), which is made of oriented jute face layer/coir with phenolic resol/resin coated rubber timber veneer/ Coir with phenolic resol/oriented jute face layer.

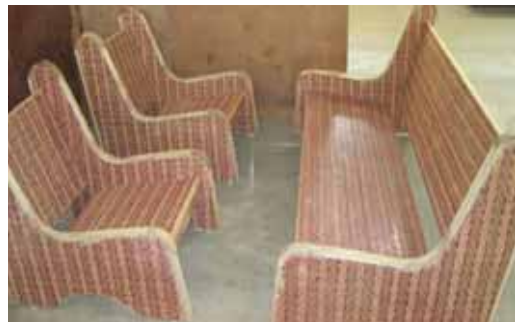
**Panel:** Panels are made with coir ply or NFRP

### 10.1.Fabrication process of coir wood panel door

Panel doors with coir composite frame made with CLVL (Coir laminated veneer lumber) and panels with coir ply or NFRP, CLVL is made by cutting an assembly which has a core of resin coated/ treated rubber timber veneers arranged with their fibre direction along length over which inner coir layers and outside jute face layer (random or oriented) are put. It is then cooled under pressure, trimmed and moisturized.

### Advantages of Coir wood

1. 100% wood substitute product – prevents felling of trees (Coir ply/ Door shutter/ rubber wood is used which is plantation rubber).
2. Biodegradable.
3. Coir and jute are agro-based materials – provide more employment in rural area.
4. Coir is available throughout the year.
5. Termite and borer resistant.
6. Better screw and nail holding properties.
7. Flame retardant.
8. Boiling water resistant.
9. Very good appearance due to oriented jute layer and can be used without painting.
10. Can be finished, painted, polished and laminated.
11. Normal carpenter's tools can be used.
12. Clear-cut edge.
13. Anti fungus.



### Properties of Coir Wood without Plantation Veneer

| Properties             |                               |
|------------------------|-------------------------------|
| Density                | 700-800 kg/m <sup>3</sup>     |
| Modulus of rupture     | 35-40 N/mm <sup>2</sup>       |
| Modulus of elasticity  | 3000 – 3500 N/mm <sup>2</sup> |
| Shear Strength         | 20-25 N/ mm <sup>2</sup>      |
| Screw holding strength | >2000 N                       |
| Nail holding strength  | >1500 N                       |
| Moisture               | 10-15 %                       |

Bureau of Indian Standards, Indian Railways, DGS & D, CPWD, Road Transport Corporation has approved the coir wood composite and it has been approved for roofing. Coir ply has also been used as shelters for the earth quake affected victims of Gujarat and has been proved as earthquake proof shelters. It is also used for packing application as sheathing of wooden crates, pallet deck boards and top and bottom lid for fibre board drum.



#### 11. Coir Composites in Packaging

Rubberised coir sheet is used for packaging for absorbing shocks and vibrations in transit. Rigid sheets of coir composites can substitute wood/plywood in various packaging applications. The strength to thickness ratio of coir composite can offer economy for packaging applications. Besides mechanical properties, due to binding resins, the board can offer resistance to water, moisture and fungus. These properties are necessary for any packaging medium and compressing sheets of coir felts impregnated with binding resins makes the board. The boards have uniform density, thickness and surface finish.



#### 12. Coconut Husk Particle Board

Coconut husk has self-bonding property and boards made using 0.5 % adhesive. The husk is cut and pieces beaten by a wooden mallet and shredded. The shreds are dried and coated





with phenol formaldehyde resin formed into mats and pressed at 150°C at 10kg/cm<sup>2</sup> for 30 minutes to get 20mm thick boards. It is a substitute to plywood for partitioning, false ceiling and paneling.

### Process of making Coir Wood



Coir Fibre



Classification and cleaning of Fibre



Needle felting



Needle felted fibre



Edge cropping of Coir Felt



Coir Felt



Jute Fibres



adhesive applied Coir felt layed along with veneer layer



composite set is ready for pressing

## 13. Products from Coir Wood

### 13.1 Bedroom furniture using Coir Wood







### 13.2 Living room furniture using Coir Wood



### 13.3 Office furniture using Coir Wood





13.4 Kitchen cabinet & drawing room furniture using coir wood



13.5 Coir Wood house



#### **14. Market Study Analysis of Composite boards**

The Analysis of the market study done on Natural Fibre based products yielded interesting and relevant findings. Relevant information from various other quarters was also used to come to the conclusions regarding the viability of the project.

From the market study done, both the builder community and the vendors are really positive on the market acceptance of the coir wood composite board. Some of the relevant points from the study are listed out as follows:

- Opinion regarding the natural fibre based products is found to be very much encouraging. The market is having a high regard for eco-friendly natural fibre based products.
- Coir and Jute are the most preferred natural fibres in the market. The products that are made using these fibres are accepted more than any other natural fibre based products.
- A good majority of vendors and builders have used natural fibre based products in their business. But their opinion is that most of the customers are not much aware of such a product and its advantages.
  - Coir based furnishing and building products are rated highly by the market. It clearly indicates a good future for coir based innovative products.
  - Both the vendors and builders are willing to use coir fibre based furnishing and building products in the future and is also willing to advise their clients/customers on using coir based products in their construction/building needs.
  - Majority of respondents have a view that the market trend is towards eco friendly products and the natural fibre based products have a good future ahead.
  - The eco-friendly trend in the market is a good news for the making industries.
  - The boom in the construction industry also adds up to the demand for natural fibre based products.
  - The gap in supply for similar furnishing and building material industry is creates an opportunity for the natural fibre industry.
  - The concern for trees and forest is a factor that favours natural fibre based products over the wood based products.
  - The natural fibre based products are as good as the wood based products in durability, quality, longevity and finish.
  - The laws against felling of trees are another factor that helps the eco friendly product industry.
  - The demand for eco-friendly products from the international market gives immense scope for such industries in India.
  - The abundance of raw material is another point that has positive bearing on coir composite board making units. Only 50 per cent of the coir husk produced is used for making any coir products in India. The balance is being wasted now.

Presently there are only 10 units manufacturing MDF Boards and 30 units manufacturing Particle Boards in India. The additional approved capacity for Particle Board wood is 282,500 TPA and for MDFB it is 350,000 TPA. The annual demand on the wood based panel industry is expected to go much beyond 300,000 TPA. But the capacity of the industry to cater to this huge demand is limited. This creates a big market for natural fibre based furnishing and building products, especially coir based.

Coir wood composite boards are going to be the next trend in the market. As the market is maturing to eco-friendly products, coir and other natural fibres have a big role to play. The market is well tuned for such eco-friendly furnishing and building material. The eco-friendly products are well received by the market and the current trend is for such products.

## **15. BIS standards for coir wood**

1. IS: 15340-2003: Specifications for Coir felt.
2. IS: 14842 – 2000: Specification for Coir Veneer Board for General Purposes.
3. IS: 15491 – 2004: Specification for Medium Density Coir Board for General Purposes
4. IS: 15887 – 2010: Specification for Coir Faced Block Board for General Purposes
5. IS: 15878 – 2010: Specification for Coir Hard Board for General Purposes

## **16. CONSTRUCTIONAL DETAILS**

### **16.1. COIR FELT**

#### **(IS 15340:2003 Specification for Coir Felt)**

This standard specifies the requirements and methods of test for two grades of coir felts having mass ranging from 600 g/m<sup>2</sup> to 1200 g/m<sup>2</sup>.

#### **Manufacture**

The coir felt is manufactured by needle punching the coir fiber web of required mass and width. Fiber webs of required mass are made by either air lay or gravity lay process. The coir felt shall be as far as possible free from ridges and creases and preferable have straight edges. Unless otherwise specified the raw material used for manufacture of coir felt shall conform to IS: 9308 (Part 3). Coir felt may also be manufactured with jute or HDPE scrim backing or any other material as agreed to between the buyer and the seller.

#### **Quality Parameters for Coir Felt**

Impurities

Mass per square meter and thickness

Moisture Content

Chloride Content

Sulphate Content

pH Value

#### **Grade and varieties**

## Coir Wood

Coir felt shall be of two grades depending upon the impurities and each grade shall be having seven varieties according to mass and thickness.

### Grades of Coir Felt

| Characteristics                 | Grades  |         |
|---------------------------------|---------|---------|
|                                 | Grade 1 | Grade 2 |
| Impurities , percent( Max)      | 5       | 7       |
| Moisture content, percent( Max) | 15      | 15      |
| Chloride content, percent( Max) | 0.60    | 0.60    |
| Sulphate content, percent( Max) | 0.25    | 0.25    |
| pH value                        | 5 - 8.5 | 5 - 8.5 |

### Physical Requirements for Coir Felts

| Sl. No.            | Variety No. | Mass g/m <sup>2</sup> | Thickness mm | Preferred Length of Felt in Roll, m |
|--------------------|-------------|-----------------------|--------------|-------------------------------------|
| i)                 | 1           | 600                   | 9            | 25                                  |
| ii)                | 2           | 700                   | 10           | 25                                  |
| iii)               | 3           | 800                   | 11           | 25                                  |
| iv)                | 4           | 900                   | 12           | 25                                  |
| v)                 | 5           | 1000                  | 13           | 25                                  |
| vi)                | 6           | 1100                  | 14           | 25                                  |
| vii)               | 7           | 1200                  | 15           | 25                                  |
| Tolerance, percent |             | ±5                    | ±5           |                                     |

### Packing and Marking

The coir felts shall be rolled individually and tied with a coir yarn at two places minimum.

Each roll shall bear the following information:

1. Manufacturer's name, initials or trade mark.
2. Name of the material
3. Nominal length, width and thickness of the material
4. Grade and variety number
5. Month and year of manufacture and

6. Any other information required by the buyer or by the law in force.

## 16.2. COIR HARDBOARD FOR GENERAL PURPOSES

### (IS 15878:2010: Specification for Coir Hardboard for general Purposes)

This standard covers the essential requirement of general purpose coir hardboard for use in dry as well as humid conditions.

#### Coir Hardboards

Coir based panel material with a normal thickness of 1.5 mm or greater, manufactured from coir needle felt (non-woven) with or without the combination of other ligno cellulosic materials like jute fibres, paper etc by the application of heat and pressure. The primary bond is usually derived from the felting of the fibres. Bonding materials and /or additives may be added.

#### Classification

Coir hardboards are generally classified into the following three types according to their method of manufacture, density and other related mechanical and physical properties.

- a) **Medium Coir Hardboard**-Coir Hardboard having uniform thickness and a density between 350 kg/m<sup>3</sup> and 800 kg/m<sup>3</sup>
- b) **Standard Coir Hardboard**-Coir Hardboard having uniform thickness and a density exceeding 800 kg/m<sup>3</sup> and
- c) **Tempered Coir Hardboard**-Coir hardboard which has been further treated in order to improve or modify one or more of their properties (this may have the effect of altering the density) and having a density exceeding 800 kg/m<sup>3</sup>.

#### Materials used

##### Coir

Coir fiber layer used in the manufacture of coir hardboard shall be uniform with minimum mass of 600g/m<sup>2</sup>.

##### Jute/ other fine fiber

Jute fiber layer or any other fine fiber layer used in the manufacture of coir hardboard shall be uniform with minimum mass of 60g/m<sup>2</sup>.

##### Paper

Paper used in the manufacture of coir hardboard shall be uniform with minimum mass of 40g/m<sup>2</sup>.

##### Adhesive

Any suitable type of synthetic resin adhesive conforming to IS 848 may be used for the purpose of bonding to comply with physical and mechanical requirements given in Table 1



### Dimensions & Tolerance

The boards shall be rectangular and unless otherwise specified, shall have square edged. The lengths of the two diagonals of the board shall not differ by more than  $\pm 3.0$  mm/m length of the diagonals.

### Width and Length

Unless otherwise specified, the width and length of coir hardboards shall be as given below

a) Width: 1.52, 1.22 mm  $\pm$  0.3 mm/m

b) Length: 3.05, 2.44, 1.83, 1.22 m

Tolerance on length shall be  $\pm 0.3$  mm/m

### Workability and Finish

#### Workability

The coir hardboard shall not crack, split or chip when drilled, sawed or nailed perpendicularly to the surface

#### Finish

The coir hardboard shall be of uniform thickness subject to the tolerance given in Table 1. They shall be free from warp. The surface shall be flat, free from cracks and lumps. At least one face shall be smooth.

### Quality parameter of Coir Hardboard for general purposes

Thickness

Density

Moisture content

Water absorption test

Swelling in thickness after immersion in water

Tensile strength parallel to surface

Modulus of rupture & modulus of elasticity

Modulus of rupture after 8 hrs boiling

Breaking load test for tempered coir hardboard

Resistance to spread of flames

Drop impact test

Flexibility test

**Table 1- Requirements of Coir Hardboards**

| SI No | Properties  | Medium Coir Hardboard  | Standard Coir Hardboard  | Tempered Coir Hardboard  |
|-------|---|--|--|--|
| 1     | Bulk Density, kg/m <sup>3</sup>   | 350 -850   | $\geq 800$   | $\geq 800$   |
| 2     | Thickness & Tolerance, mm   | 1.5 $\pm$ 0.4<br>2.0 $\pm$ 0.4<br>3.0 $\pm$ 0.4<br>4.0 $\pm$ 0.5<br>6.0 $\pm$ 0.5<br>8.0 $\pm$ 0.7<br>10.0 $\pm$ 0.7<br>12.0 $\pm$ 0.9 | 1.5 $\pm$ 0.4<br>2.0 $\pm$ 0.4<br>3.0 $\pm$ 0.4<br>4.0 $\pm$ 0.5<br>6.0 $\pm$ 0.5<br>8.0 $\pm$ 0.7<br>10.0 $\pm$ 0.7<br>12.0 $\pm$ 0.9 | 1.5 $\pm$ 0.4<br>2.0 $\pm$ 0.4<br>3.0 $\pm$ 0.4<br>4.0 $\pm$ 0.5<br>6.0 $\pm$ 0.5<br>8.0 $\pm$ 0.7<br>10.0 $\pm$ 0.7<br>12.0 $\pm$ 0.9 |
| 3     | Squareness(max), mm /m  | 3  | 3  | 3  |
| 4     | Edge straightness(max) mm/m   | 2  | 2  | 2  |
| 5     | Moisture content, %   | 5-15   | 5-15   | 5-15   |
| 6     | Water absorption after 24 hrs soaking, (max)%   | 65   | 40   | 25   |
| 7     | Swelling in thickness 24 h after immersion in water(max)%   | 25   | 25   | 5  |
| 8     | Tensile strength parallel to surface (min), N/mm <sup>2</sup>   | -  | -  | 0.25   |
| 9     | Modulus of rupture(min), N/mm <sup>2</sup><br>a) Upto and including 3.0 mm<br>b) 4.0 to 12.0 mm                   | 12<br>16   | 30<br>30   | 50<br>50   |
| 10    | Modulus of elasticity(min), N/mm <sup>2</sup>   | 2000   | 3000   | 4000   |
| 11    | Modulus of rupture after 8 h boiling(min), N/mm <sup>2</sup><br>a) Upto and including 3.0 mm<br>b) 4.0 to 12.0 mm | 5<br>8   | 15<br>15   | 30<br>30   |

|    |  |   |   |                  |
|----|--|---|---|------------------|
| 12 | Breaking load along the length and width,(min) ,N,Min. | - | - | 360              |
| 13 | Tensile Strength, (min), N/mm <sup>2</sup>             | - | - | 25               |
| 14 | Resistance to spread of flame                          | - | - | To pass the test |
| 15 | Drop impact test                                       | - | - | To pass the test |
| 16 | Flexibility  | - | - | To pass the test |

### Marking

Each coir hardboard shall be legibly marked near any of its corners with the following:

1. Name of the manufacturer
2. Type of coir hardboard
3. Dimension and thickness
4. Date of manufacture, and
6. The criteria for which coir hardboard has been labeled as Eco Mark.

### 16.3. MEDIUM DENSITY COIR BOARDS FOR GENERAL PURPOSES

#### (IS 15491:2004: Specification for Medium Density Coir boards for General Purposes)

Medium density coir board is the latest development in the panel industry. It is a panel material manufactured from renewable natural fibres such as coir, jute and paper impregnated with synthetic resin or other suitable binder. The panels are manufactured to a specific gravity of 0.5 to 0.9 by the application of heat and pressure by a process in which the inter fiber bond is substantially created by the added binder. Other materials may have been added during manufacturing to improve certain properties. Grade 1 & Grade 2 medium density coir boards may be used in Hazard Class 1<sup>1)</sup> and Hazard Class 2<sup>2)</sup>, where as Grade 3 boards may be used in Hazard Class 1 only.

<sup>1)</sup> **Hazard Class 1-Environment with relative humidity less than or equal to 70%**

**and <sup>2)</sup> Hazard Class 2 - Environment with relative humidity more than 70%**

### Scope

This standard covers the requirement of medium density coir boards for general purposes having density in the range of 500-900 kg/m<sup>3</sup> and does not cover veneered, laminated, other

specially treated boards, moulded boards etc.

### Additive

Any material introduced prior to the final consolidation of a board to increase bulking or to improve some property of the final board. Fillers and preservatives are included under this item. Alum was resin etc may be added to increase water resistance.

### Grades

| Grades               | Designation |
|----------------------|-------------|
| Solid Board, Grade 1 | Grade 1     |
| Solid Board, Grade 2 | Grade 2     |
| Solid Board, Grade 3 | Grade 3     |

### Materials used

#### Coir

Coir fiber layer used in the manufacture of medium density coir boards shall be uniform with minimum mass of  $600\text{g/m}^2$ . The coir needled felt is manufactured by mechanical inter-loop of coir fleece by use of barb needles to form a non-woven felt of different densities.

#### Jute

Jute fiber layer or any other fine fiber layer used in the manufacture of medium density coir boards shall be uniform with minimum mass of  $60\text{g/m}^2$ .

#### Paper

Paper used in the manufacture of medium density coir boards shall be uniform with minimum mass of  $40\text{g/m}^2$ .

#### Adhesive

BWR type of synthetic resin adhesive conforming to IS 848 shall be used for the purpose of bonding for Grade 1, Grade 2, Grade3 boards to comply with physical and mechanical requirements given in table 1.

### Manufacture

Coir fibers are manufactured by mechanical means is processed through needled felt plant (Non-woven system) to make uniform mat in different densities according to the requirement.

To give a smooth surface, fine fibres like jute fibres are carded and spread to give a uniform layer on suitable carrier like paper. These fibre mats thus produced are then impregnated with resin and later pressed into panels by passing into press under controlled temperature, pressure and time.

### Finish

## Coir Wood

Medium density coir boards shall be uniform thickness and density throughout the length and width of the boards. All medium density coir boards shall be flat. Both surfaces of the boards shall have smooth finish.

### Dimensions and Tolerance

The boards shall be rectangular and shall have square edges. The length of the two diagonals of the board shall not differ by more than  $\pm 3.0$  mm/m length of the diagonals.

### Thickness

Thickness of medium density coir boards: 3, 4, 6, 8, 9 mm and Tolerance below 9mm thickness is  $\pm 0.30$  mm

12, 15, 18, 22 mm and Tolerance above 9mm is  $\pm 0.60$ mm

### Width and Length

Width 1.22 mm and Tolerance  $\pm 0.30$  mm/m

Length: 5.49, 4.89, 3.66, 3.05, 2.44, 1.83, 1.22 m and Tolerance  $\pm 0.30$  mm/m

### Quality Parameter of Medium Density Coir boards for General Purposes

Accuracy of dimension of boards

Density

Moisture content

Water absorption

Linear expansion (swelling in water)-i) Due to General absorption ii) Due to Surface absorption

Modulus of rupture & Modulus of elasticity

Tensile strength (Test for internal bond)

Screw withdrawal strength

Nail withdrawal strength

Resistance to spread of flames

**Table 1- Physical and Mechanical Requirements of Medium Density Coir boards for General Purposes**

| SI No | Properties                     | Grade 1  | Grade 2  | Grade3   |
|-------|--------------------------------|----------|----------|----------|
| 1     | Density, kg/m <sup>3</sup>     | 650-900  | 500-900  | 500-900  |
| 2     | Variation from mean density, % | $\pm 10$ | $\pm 10$ | $\pm 10$ |

|   |  |  |  |  |
|---|--|--|--|--|
| 3 | Moisture content, %  | 5-15   | 5-15   | 5-15   |
| 4 | Variation from mean moisture content, % absolute   | ±3   | ±3   | ±3   |
| 5 | Water absorption , % max<br>1)After 2 h soaking<br>2) After 24 h soaking<br>a) Upto and including 6 mm<br>b) 8-12 mm<br>c) 13 -19 mm<br>d) 20 mm and above   | 6<br><br>30<br>20<br>13<br>12                            | 6<br><br>30<br>20<br>13<br>12                            | 9<br><br>45<br>30<br>20<br>18                            |
| 6 | Linear expansion(swelling in water) , % max<br>1) General absorption after 24 h soaking<br>a) Thickness<br>b) length<br>c) Width<br>ii)Surface absorption( in thickness) after 2 h soaking   | 4<br>0.3<br>0.3<br>4                                     | 4<br>0.3<br>0.3<br>4                                     | 7<br>0.4<br>0.4<br>5                                     |
| 7 | Modulus of rupture, min N/mm <sup>2</sup><br>1) In dry condition<br>a) Upto and including 20 mm thickness<br>i)Average<br>ii) Minimum individual<br>b) Above 20 mm thickness<br>i)Average<br>ii) Minimum individual<br>2) After 8 h boiling<br>a) Upto and including 20 mm thickness<br>i)Average<br>ii) Minimum individual<br>b) Above 20 mm thickness<br>i)Average<br>ii) Minimum individual | 31<br>27<br><br>27<br>23<br><br>17<br>15<br><br>15<br>13 | 29<br>25<br><br>25<br>22<br><br>NA<br>NA<br><br>NA<br>NA | 29<br>25<br><br>25<br>22<br><br>NA<br>NA<br><br>NA<br>NA |
| 8 | Modulus of elasticity, N/mm <sup>2</sup><br>1) Upto and including 12 mm thickness<br>a)Average<br>b) Minimum individual<br>2) Above 12mm thickness<br>a)Average<br>b) Minimum individual   | 2800<br>2500<br><br>2500<br>2300                         | 2800<br>2500<br><br>2500<br>2300                         | 2800<br>2500<br><br>2500<br>2300                         |



|    |   |                                  |                                  |                                  |
|----|---|----------------------------------|----------------------------------|----------------------------------|
| 9  | Tensile strength perpendicular to the surface (internal bond), min, N/mm <sup>2</sup><br>1) Upto and including 20 mm thickness<br>a)Average<br>b) Minimum individual<br>2) Above 20mm thickness<br>a)Average<br>b) Minimum individual | 0.9<br>0.8<br><br>0.8<br>0.7     | 0.9<br>0.8<br><br>0.8<br>0.7     | 0.8<br>0.7<br><br>0.7<br>0.6     |
| 10 | Tensile strength perpendicular to the surface (internal bond), min, N/mm <sup>2</sup><br>After accelerated water resistance *<br>a)Average<br>b) Minimum individual   | 0.45<br>0.40                     | 0.45<br>0.40                     | -<br>-                           |
| 11 | Screw withdrawal strength, N<br>1) Face:<br>a)Average<br>b) Minimum individual<br>2) Edge( For thickness > 12 mm)<br>a)Average<br>b) Minimum individual   | 2300<br>2000<br><br>1700<br>1500 | 1725<br>1500<br><br>1400<br>1250 | 1725<br>1500<br><br>1400<br>1250 |
| 12 | Nail holding strength, N<br>1) Face:<br>a)Average<br>b) Minimum individual<br>2) Edge( For thickness > 12 mm)<br>a)Average<br>b) Minimum individual   | 1400<br>1250<br><br>1400<br>1250 | 1400<br>1250<br><br>1400<br>1250 | 1400<br>1250<br><br>1400<br>1250 |
| 13 | Resistance to spread of flame   | To pass the test                 | -                                | -                                |

\* Accelerated water resistance test-Specimens are immersed in water at 27± 2°C and water is brought to boiling and kept at boiling temperature for 4 hour for Grade 1 and 2 h for Grade 2. Specimens are then cooled in water to 27± 2°C and dried in ambient condition before determining the tensile strength perpendicular to the surface (internal bond).

#### 16.4. COIR VENEER BOARD FOR GENERAL PURPOSES

##### (IS 14842:2000 Specifications for Coir Veneer Board for General Purposes)

##### Scope

This standard covers the method of manufacture and the requirements of coir veneer board (coconut fiber with veneer) for general purposes. Coir veneer board is a panel material manufactured with a combination of coconut fiber needle felt, veneer and jute fibres with paper impregnated with suitable resin adhesive and wood veneers. Coconut fibre needled felt can be used as core/ cross bands or as outer skins formed with jute fibres

and craft paper. However, the composite ply should be balanced construction on either side of central ply. The blended mass of glued fibres is laid to form a mat which is pre needled. Alum, wax resins or other additive may be introduced to the agglomerate for coir veneer board prior to forming primarily to increase water resistance.

### **Grades**

- a) Boiling water resistant (BWR) Grade
- b) Moisture resistant (MR) Grade

### **Materials**

#### **Coir**

Coir fiber layer used in the manufacture of coir veneer boards shall be uniform with minimum mass of  $600\text{g/m}^2$ . The coir needled felt is manufactured by mechanical inter-loop of coir fleece by use of barb needles to form a non-woven felt of different densities.

#### **Jute**

Jute fiber layer or any other fine fiber layer used in the manufacture of coir veneer boards shall be uniform with minimum mass of  $60\text{g/m}^2$ .

#### **Adhesive**

Adhesive for manufacture of coir veneer boards shall conform to BWR/MR of IS 848 for BWR/MR grade boards.

#### **Paper**

Paper used in the manufacture of coir veneer boards shall be uniform with minimum mass of  $40\text{g/m}^2$ .

#### **Veneer**

Any species of timber may be used for the manufacture of veneers.

#### **Thickness**

Thickness shall be - uniform with a tolerance of  $\pm 5\%$

#### **Manufacture**

Coconut fibers manufactured by mechanical means is processed through needled felt plant (Non-woven system) to make uniform mat in different densities according to the requirement. Jute fibres are carded and spread to give a uniform layer on paper. These fibre mats thus produced are blended with resin and wax, if required. The impregnated fibre mats thus produced are sandwiched with wood veneer in a press under controlled temperature and pressure.

Veneer shall either rotary cut or sliced. Veneers from non-durable species and sapwood of all species shall be soaked in 1.25% boric acid equivalent solution at a temperature of  $85-90^\circ\text{C}$  for a period of 10-40 min depending up on the thickness of the veneers or the veneer may be dipped in 2% boric acid equivalent solution for 2min and block stacked at least for 2h. Thickness shall be uniform with at tolerance of  $\pm 5\%$ .

### Application of adhesive

Coconut fibre needle felt and jute fibres with paper shall be applied with the adhesive either by spaying/ soaking/ spreading process.

Adhesive coated coconut fiber needled felt and jute fiber with t paper to attain cohesiveness shall be allowed sufficient length to open assembly time and/ or passed through a band drier at a temperature ranging between 80-90 °C to bring down the moisture content of adhesive coated coconut fiber needled felt to 8 to 12 %. Adhesive coated and conditioned coconut fiber needled felt and veneer shall be assembled alternatively with layer of conditioned adhesive coated jute fibres with paper forming as face layer in such a way that either side of the central ply same material and thickness is used to get balanced construction. The assembly shall be hot pressed at not less than 140°C for BWR grade and at 100-110°C for MR grade at a specific pressure of 2.0-3.0 N/mm<sup>2</sup>.

### Permissible Defects:

1. Gaps in cores and cross bands shall not be permitted
2. Splits in cores and cross bands may be permitted to an extent of 2 per core or Cross band.
3. Overlap shall be permitted in core/cross bands only.

### Dimensions and Tolerances

#### Dimensions

2400 x 1200 mm                      1800 x 1200 mm

2100 x 1200 mm                      1800 x 900 mm

The thickness of coir veneer board shall be 3, 4, 5,6,9,12,16,18,20,25 mm

#### Tolerance , Dimension and Tolerance, mm

| Dimension   | Tolerance, mm           |
|---|-------------------------|
| Length  | +6<br>-0                |
| Width   | +3<br>-0                |
| Thickness<br>i) Less than 6 mm<br>ii) 6mm and above | 10%<br>5%               |
| Edge straightness                                   | 2 mm per 1000 mm (0.2%) |
| Squareness  | 2 mm per 1000 mm (0.2%) |

### Quality parameter of Coir Veneer Board for General Purposes

Glue adhesion

Glue shear strength in dry state

Micological Test

Water resistant test

Moisture content

**Average and Minimum Individual Glue Shear Strength for Coir Veneer Board**

| Sl. No. | Grade                         | Shear Strength Minimum (N) |             |                  |
|---------|-------------------------------|----------------------------|-------------|------------------|
|         |                               | Dry State                  | Mycological | Water Resistance |
| 1       | BWR                           |                            |             |                  |
|         | Average<br>Minimum Individual | 1350<br>1100               | 1000<br>800 | 1000<br>800      |
| 2       | MR                            |                            |             |                  |
|         | Average<br>Minimum Individual | 1000<br>800                | 800<br>650  | 800<br>650       |

**Average and Minimum Individual values of Modulus of Elasticity (MOE) & Modulus of Rupture (MOR)**

| Grade                         | MOE(N/mm <sup>2</sup> ) | MOR(N/mm <sup>2</sup> ) |
|-------------------------------|-------------------------|-------------------------|
| BWR                           |                         |                         |
| Average<br>Minimum Individual | 3000<br>2700            | 30<br>27                |
| MR                            |                         |                         |
| Average<br>Minimum Individual | 2500<br>2200            | 25<br>22                |

**Marking**

Each coir veneer board shall be legibly and indelibly marked or stamped with the following

- Indication of the source of manufacture
- Year of manufacture
- Batch No. and
- The grade and type as follows:
  - Boiling water resistant (BWR), and
  - Moisture resistant (MR)

All marking shall be done on the face of coir veneer board near one corner.

## 16.5. COIR FACED BLOCK BOARDS

### (IS: 15887 – 2010: Specification for Coir Faced Block Boards)

Coir faced block board is a recently developed product in the panel industry. It finds use in bus bodies, furniture making, partitioning, paneling etc. Coir faced block board is manufactured from coir and jute fibres combined with synthetic resin or other suitable binder. The panels are manufactured by the application of heat and pressure by a process in which the inter fiber bond is substantially created by the added binder. Other materials may also be added during manufacture to improve specific properties. This indigenous technology utilized to manufacture coir faced block board is an improvisation of that used by the existing block board industry and has been developed by Central Institute of Coir technology, Bangalore, a research institute of Coir Board.

#### **Coir Faced Block Board**

These are boards having a core and border strips made up of wood, the core strips each not exceeding 30 mm in width and the border strips of minimum 45 mm in width which may not be glued together. The core is glued between one or more outer surface layers formed with coir and bast fibers like jute with paper. The core strips can be made of compressed coir strips also, of width.

#### **Scope**

This standard covers the essential requirements of commercial and decorative Coir faced block boards meant both for interior and exterior uses.

#### **Grades& Types**

- a) BWP Grade- Coir faced block board that are likely to be exposed to high humidity and meant for exterior use.
- b) MR Grade- Coir faced block board that are meant for interior use in furniture, partitions etc.

#### **Other grades**

The BWP Grade and MR Grade Coir faced block boards shall be of following two types.

- a) **Decorative Type**- These are coir faced block boards with oriented surface finish made by coir and fine fibres like jute with paper, surfaces on both sides for use in high class furniture paneling, interior decoration, partitions etc.
- b) **Commercial Type**- These are coir faced block boards of commercial type with random surface finish made by coir and fine fibers like jute with a paper on both surface for use in ordinary furniture, tabletops, partitions and paneling to be painted over flooring and seats of bus bodies, railway carriage, etc.

#### **Designation**

The grades and types of coir faced block boards shall be designated by the symbols below:

| Grade and type             | Symbol   |
|----------------------------|----------|
| BWP grade, decorative type | BWP-DEC  |
| BWP grade, commercial type | BWP-COM  |
| MR grade, decorative type  | MR - DEC |
| MR grade, commercial type  | MR - COM |

## Materials

### Coir

Coir fiber layers used in the manufacture of coir faced block board shall be uniform with a minimum mass of 600 gm/m<sup>2</sup>.

### Jute /Other fine fibers

Jute fiber layer or any other finer fiber used in the manufacture of coir faced block board shall be uniform with a minimum mass of 40 gm/m<sup>2</sup>.

### Paper

Paper used in the manufacture of coir faced block board shall be uniform with a minimum mass of 40 gm/m<sup>2</sup>.

### Adhesive

The adhesive used for the bonding purpose shall be of BWP type conforming to IS 848 for BWP grade. For MR grade, adhesive should conform to IS 848.

### Timber

Any suitable species of timber may be used for manufacture of coir faced block board.

## Manufacture

### Core

Coir faced block boards shall be manufactured using wooden strips/compressed coir strips or as the core. Compressed coir strips used shall be of density between 300 and 800kg/cm<sup>3</sup>, depending on the grade of coir faced block boards. The Width of each compressed coir strip shall not exceed 80 mm and shall be supported with a strip of wooden core.

The wooden strips when used for core and for border shall be cut from timber seasoned to moisture content not exceeding 12%. The width of each core strip of wood shall not exceed 30mm and the border strip shall be a minimum of 45mm wide. These strips may consist of pieces of small lengths placed end to end where the end joints shall be staggered. In any one block board, the core strips shall be of one species of timber only.

### Cross bands and faces

#### Veneers for cross bands

Shall be rotary cut/sliced and smooth. Cross bands shall be not less than 1.0 mm but not more than 3.0mm in thickness.



### Faces

Faces manufactured by mechanical means are processed through needled felt plant (Non-woven system) to make uniform mat in different densities according to the requirement. For smoothness, fine fibers like jute are carded and spread to give a uniform layer on suitable carrier like paper. These fibre mats thus produced are then impregnated with resin and wax. The impregnated fibre mats with veneer as cross bands along with core are pressed into panels by passing into press under controlled temperature and pressure.

The construction shall be well balanced around the central line.

### Dimensions & Tolerances

Thickness-12, 15, 19, 20, 25, 30, 32, 35, 40, 45/50 mm

### Size

| Length(mm) | Width (mm) |
|------------|------------|
| 2440       | 1220       |
| 2140       | 1220       |
| 2140       | 920        |
| 1830       | 1220       |
| 1830       | 920        |

### Tolerance

#### Dimension and Tolerance, mm

| Dimension                       | Tolerance, mm           |
|---------------------------------|-------------------------|
| Length                          | +6<br>-0                |
| Width                           | +3<br>-0                |
| Thickness                       | ±5%                     |
| Variation of thickness of board | not more than 0.5 mm    |
| Edge straightness               | 2 mm per 1000 mm (0.2%) |
| Squareness                      | 2 mm per 1000 mm (0.2%) |

### Quality parameters for Coir Faced Block Boards

Dimensional changes caused by humidity

Resistance to water

Adhesion of plies

Mycological tests

Modulus of rupture and Modulus of elasticity

Spot test for penetration and identification of preservative like copper-chromium-arsenic composition, acid –cupric-chromate composition, borated-copper-chrome composition and ammoniacal-copper-arsenite composition

### Marking

Each coir faced block board shall be legibly and indelibly marked or stamped with the following

- Indication of the source of manufacture
- Grade and type of block board
- Size (length, width and thickness)
- Batch number and Year of manufacture and
- Criteria for which the block board have been labelled as ECO MARK

### Average and Minimum Individual values of Modulus of Elasticity (MOE) & Modulus of Rupture (MOR) of BWP &MR Grades

|  | BWP Grade | MR Grade |
|--|-----------|----------|
| Modulus of rupture , N/mm <sup>2</sup>   |           |          |
| i) Average                               | 32        | 28       |
| ii) Minimum Individual                   | 28        | 25       |
| Modulus of Elasticity, N/mm <sup>2</sup> |           |          |
| i)Average                                | 4000      | 3500     |
| ii) Minimum Individual                   | 3500      | 3000     |

## 17. Project Profiles

### 17.1. Project for Manufacture of Coir Medium Density Fibre Boards (18 mm from Coir Needled Felt)

#### Highlights of Project

|   |   |
|---|---|
| Product   | Coir composite panels   |
| Application Area  | This is a plywood/wood replacement product and can be used as an alternative material |
| Size  | 2.44 mt x 1.22 mt   |
| Capacity  | 160 panels per day  |
| Land Requirement<br>(land cost not included in the project) | 40000 sq.ft   |
| Building Requirement  | 20000 sq. ft  |

|                               |                                      |
|-------------------------------|--------------------------------------|
| Raw Material                  | Coir fibre<br>Thermosetting adhesive |
| Consumables                   | Oil grease releasing paper etc       |
| Electricity                   | 125 hp                               |
| Labour Requirement            | 40 persons                           |
| Turnover                      | 645.12 Lakhs                         |
| Cost of Machinery             | Rs.167.00 lakhs                      |
| Cost of Building              | Rs.150.00 lakhs                      |
| Working capital<br>(3 months) | Rs.184.41 lakhs                      |

### Introduction

India is currently experiencing a construction boom and there are no indications that this situation is going to change in the immediate future. In fact it seems very likely that the boom will continue unhindered for many years, as India's rapid economic growth creates a need for modern housing, shopping malls, sports facilities, schools and other public buildings. This will create good demand for wooden panels. Forecasts of likely growth in housing, based on population growth of 2% per annum, indicate that the building stock will rise by 6 million units each year.

The recent development in the coir is coir composite wherein the coir is bonded with thermosetting adhesive to form a different novel product which has got the properties similar to wood in application. Coir composite panel being an important building material which is a replacement of wooden panels will be of great demand in India in future. Equipping with the state of art facility for the manufacture of coir composites will not only cater the demand of the building materials but also a scope for the outlet for coir industry with value addition.

### Product Characteristics

- Coir-composites are Phenol Bonded Board.
- Stronger as it is made of Fibre known for its strength and load bearing properties.
- Attractive natural look and can be used as it is.
- Can be painted, polished or laminated.
- Water proof with minimum surface absorption
- More economical than other phenol bonded boards.
- Good smooth appearance on both sides.
- Strong and rigid
- Termite and insect resistant.
- Flame Retardant.
- Can be Nailed, Screwed and Cut Sharply.

- Interior of furniture and cabinets made with Coir ply need not be painted or polished.
- Environment friendly
- Low Paint consumption

### Applications

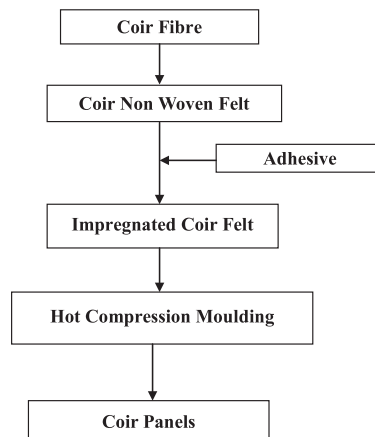
- Building industry as doors, door inserts, door frames, wall panelling, flooring, false roofing, partition panels, roofing sheets etc.
- Furniture industry as table, chairs, wardrobes, computer table, cot, TV cabinets, dining table, table tops for cafeteria, school benches etc.
- Automotive industry as backing for seats, roof insulation boards, side door panelling, railway seats, walls, roof etc.

### Manufacturing Process

The coir fibres which are stored as bales are opened out and passed through the fibre cleaning machine. During this process the hard bits coir pith and other foreign particles are removed. Cleaned and opened coir fibre is passed into a sheet forming machine by air laying process to form a uniform web. The density is adjusted to get continuous and even distribution for the uniform web formation. The web thus formed is passed through needling loom. During this process needles will interlock coir fibre mechanically. The needles pattern and the depth of penetration are positioned to suit the required interlocked coir needle felt. These interlocked needle felt are edge trimmed through the longitudinal cutter and made into required rolls. The edge trimmed rolls are taken into the impregnation section where thermosetting adhesive is impregnated on to the non woven sheet. These impregnated non wovens are dried to remove the excess moisture to form prepregs. These prepregs are cut to required length and kept ready for assembling.

The coir prepregs thus formed are laminated as per the required thickness and strength characteristics and then loaded on to the compression moulding machine. The assemblies thus placed between the moulds of the machine are cured with specific pressure, temperature and time. The cured panel is taken out and conditioned. Each panel is then inspected and checked for quality for maintaining standards.

### Flow of Materials



**DETAILS OF PROJECT**

|                      |                                      |
|----------------------|--------------------------------------|
| Product              | Coir composite panels                |
| Size                 | 2.44 mt x 1.22 mt                    |
| Capacity             | 160 panels per day of 2 shift        |
| Land Requirement     | 40000 sq.ft                          |
| Building Requirement | 20000 sq. ft                         |
| Raw Material         | Coir fibre<br>Thermosetting adhesive |
| Consumables          | Oil grease etc                       |
| Electricity          | 125 hp                               |
| Labour Requirement   | 40 persons                           |

**Machineries Required**

|          |  |       |        |
|----------|--|-------|--------|
| 1        | Coir cleaning machine                                | 1 no  | 5 hp   |
| 2        | Coir felt machine                                    | 1 no  | 30 hp  |
| 3        | Coir felt impregnation machine with online drier     | 1 no. | 30 hp  |
| 4        | Hot compression moulding machine with heating system | 1 no. | 40 hp  |
| 5        | Edge trimming machine                                | 1 no  | 10 hp  |
| Total hp |  |       | 115 hp |

**Cost of the Machineries**

|                             |   |         |                 |
|-----------------------------|---|---------|-----------------|
| 1                           | Coir cleaning machine   | 1 no    | Rs.3.00 lakhs   |
| 2                           | Coir felt machine-2.44 mt width   | 1 no    | Rs.36.00 lakhs  |
| 3                           | Coir felt impregnation machine with drier                                       | 1 no.   | Rs.25.00 lakhs  |
| 4                           | Hot compression moulding machine with boiler                                    | 1 no.   | Rs.79.00 lakhs  |
| 5                           | Edge trimming machine   | 1 no    | Rs.4.00 lakhs   |
| 6                           | Caul plates   | 10 sets | Rs.5.00 lakhs   |
|                             | Installation & other charges such as scissor lift, wiring, fork lift system etc | -       | Rs.15.00 lakhs  |
| Total cost of the machinery |   |         | Rs.167.00 lakhs |

**Project Cost**

1. **Land Requirement:** The land required for making coir panel is about 40000 sq.ft  
Actual cost of the land varies depending on the locality and the local rates but for

the project the land cost is not included here in the project and the entrepreneur has to have his own land.

2. **Building Requirement:** about 12000 sq.ft of AC roofing sheet building is sufficient for the project. The cost of building is taken here as Rs.150.00 lakhs.
3. **Machinery Cost:** The total machinery cost is estimated to be Rs.167.00 lakhs.

### Cost of the Project

|             |                         |
|-------------|-------------------------|
| Land        | not taken in to account |
| Building    | Rs. 150.00 lakhs        |
| Machineries | Rs. 167.00 lakhs        |

**Total cost of the project is Rs.317.00 lakhs.**

### Production Data

|                             |                               |
|-----------------------------|-------------------------------|
| Size of panel               | 2.44 mt x 1.22 mt             |
| Capacity per hour           | 10 panels per hour            |
| No of shifts                | 2                             |
| Production per day          | 10 x 8 x 2 = 160 panels       |
| Production per annum        | 48000 panels                  |
| Rate of sheet               | Rs.2240=00 per panel          |
| Working days per year       | 300 days(25 days x 12 months) |
| Total income per annum      | Rs. 1075.00 lakhs             |
| Total expenditure per annum | Rs. 812.78 lakhs              |
| Profit per annum before tax | Rs. 262.22 lakhs              |

### Setting up of a manufacturing unit for Coir felt panels from coir needled felt 18 mm thick full coir board

#### Project Profile

#### Production capacity per annum

|                      |                        |
|----------------------|------------------------|
| Production per day   | 160Panels per day      |
| Production per annum | 48000 Panels per annum |
| Turnover             | Rs.645.12 lakh         |

#### I Financial Aspects

#### i) Fixed Capital



|  |   |
|--|---|
| <b>a) Land and Building</b>  |   |
| Land area  | 40000 sq.ft                             |
| Built up area  | 20000 sq.ft                             |
| Cost of building   | Rs.150.00 lakh                          |
| Total cost of land and building                                    | Rs.297.00 lakh ( land not included)     |
| b) Machinery and Installation                                      | Rs.167.00 lakh                          |
| <b>II Working Capital</b>  |   |
| a) Raw materials per month   | Rs.45.36 lakh                           |
| b) Electricity, fuel and water charges                             | Rs.5.00 lakh                            |
| c) Man power cost(including benefit)                               | Rs.9.86 lakh                            |
| d) Other expenses  | Rs.0.50 lakh                            |
| e) Marketing expenses  | Rs.0.75 lakh                            |
| Total expenses per month   | Rs.61.47 lakh                           |
| Working Capital for 3 months                                       | Rs.184.41 lakh                          |
| <b>III Total Capital Investment</b>                                | = Fixed capital + Working capital       |
| Total Capital Investment   | Rs.501.41 lakh                          |
| <b>IV Financial Analysis</b>                                       |   |
| <b>a) cost of production</b>                                       |   |
| Working capital x 4  | Rs.737.64. lakh                         |
| Depreciation of building@5%  | Rs.8.00 lakh                            |
| Depreciation of Machinery @ 10%                                    | Rs.15.00 lakh                           |
| Interest on the loan taken (80% of total capital investment @ 13%) | Rs.52.14 lakh                           |
| <b>Total cost of production</b>                                    | Rs.812.78 lakh                          |
| <b>b) Turnover per year</b>  |   |
| Selling cost of the product  | Rs 2240.00 per panel(Rs.70/sq.ft)       |
| Qty produced   | 48000                                   |
| Total turnover per year  | Rs.1075.00 lakhs                        |
| <b>c) Net Profit per year</b>                                      |   |
|  | = total turnover – total cost of prodn. |
|  | Rs.262.22 lakhs                         |

## 17.2. Project for Manufacture of Coir Pith Wood Waste Composite Panels (Phenolic resin 18mm board)

### Highlights of the Project

|   |   |
|---|---|
| Product   | Coir pith and wood waste composite panels   |
| Application Area  | This is a plywood/wood replacement product and can be used as an alternative material |
| Size  | 2.44 mt x 1.22 mt x 12 mm   |
| Capacity  | 96 panels per shift   |
| Land Requirement<br>(land cost not included in the project) | 20000 sq.ft   |
| Building Requirement  | 15000 sq. ft  |
| Raw Material  | Coir pith<br>Wood waste<br>Phenolic resin   |
| Consumables   | Oil grease, releasing paper etc   |
| Electricity   | 70 hp   |
| Labour Requirement  | 30 persons  |
| Turnover  | Rs. 460.80 Lakhs  |
| Cost of Machinery   | Rs.100.00 lakhs   |
| Cost of Building  | Rs.100.00 lakhs   |
| Working capital<br>(3 months)                               | Rs. 79.35 lakhs   |

### Applications

- Building industry as doors, door inserts, door frames, wall panelling, flooring, false roofing, partition panels, roofing sheets etc.
- Furniture industry as table, chairs, wardrobes, computer table, cot, TV cabinets, dining table, table tops for cafeteria, school benches etc.
- Automotive industry as backing for seats, roof insulation boards, side door panelling, railway seats, walls, roof etc.

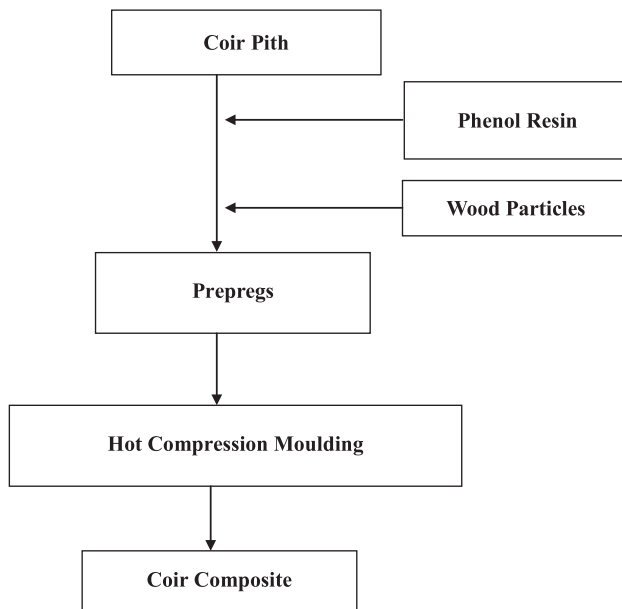
### Manufacturing Process

Coir pith are first mixed with urea/phenol resin in the ratio of 1:1 and made in to homogeneous small particles by mixing machine. The coir pith thus impregnated is mixed in the ratio of 1:2 by weight with wood particles. These are spread in the assembly table and prepregs are formed with top and bottom releasing sheets and with caul plates. These prepregs thus formed are loaded on to the compression moulding machine. The assemblies thus placed are cured with specific pressure of 20 kg/cm<sup>2</sup>, temperature of 130° C and 15

## Coir Wood

minutes time. The cured panel is taken out and conditioned. Each panel is then inspected and checked for quality for maintaining standards.

### Flow of Materials



### Details of the Project

|                      |   |
|----------------------|---|
| Product              | Coir pith& wood particle panels                           |
| Size                 | 2.44 mt x 1.22 mt   |
| Capacity             | 96 panels per shift                                       |
| Land Requirement     | 20000 sq.ft   |
| Building Requirement | 15000 sq. ft  |
| Raw Material         | Coir pith and wood particles<br>Phenol formaldehyde resin |
| Consumables          | Oil grease, releasing paper etc                           |
| Electricity          | 80 hp   |
| Labour Requirement   | 30 persons  |

### Machineries Required

|   |   |       |       |
|---|---|-------|-------|
| 1 | Coir pith and resin mixing machine                                  | 2 no  | 10 hp |
| 2 | Coir pith and wood particle Mixing machine                          | 1 no  | 10 hp |
| 3 | Hot compression moulding machine three daylight with heating system | 1 no. | 25 hp |

|   |                       |       |       |
|---|-----------------------|-------|-------|
| 4 | Edge trimming machine | 1 no. | 10 hp |
| 5 | Boiler and misc       | 1 no  | 22 hp |

**Cost of the Machineries**

|                                    |   |         |                        |
|------------------------------------|---|---------|------------------------|
| 1                                  | Coir pith mixing machine  | 2 nos   | Rs.5.00 lakhs          |
| 2                                  | Coir pith and wood particle Mixing machine                          | 1 no    | Rs.10.00 "             |
| 3                                  | Hot compression moulding machine three daylight with heating system | 1 no.   | Rs.50.00 "             |
| 4                                  | Edge trimming machine   | 1 no.   | Rs.5.00 "              |
| 5                                  | Boiler and misc   | 1 no    | Rs.15.00 "             |
| 6                                  | Caul plates   | 10 sets | Rs.5.00 "              |
|                                    | Installation & other charges such as scissor lift, wiring etc       | -       | Rs.10.00 "             |
| <b>Total cost of the machinery</b> |   |         | <b>Rs.100.00 lakhs</b> |

**Production Data**

|                             |                               |
|-----------------------------|-------------------------------|
| Size of panel               | 2.44 mt x 1.22 mt x 12 mm     |
| Capacity per hour           | 6 panels per hour             |
| No of shifts                | 2                             |
| Production per day          | 96 panels                     |
| Production per annum        | 28800 panels                  |
| Rate of sheet               | Rs.1600=00 per panel          |
| Working days per year       | 300 days(25 days x 12 months) |
| Total income per annum      | Rs. 460.80 lakhs              |
| Total expenditure per annum | Rs. 361.45 lakhs              |
| Profit per annum before tax | Rs. 99.35 lakhs               |

**Setting up of a Manufacturing Unit for Coir Panels****Project Profile****Production capacity per annum**

|                      |                        |
|----------------------|------------------------|
| Production per Shift | 96 panels per shift    |
| Production per annum | 28800 Panels per annum |
| Turnover             | Rs. 460.80 lakh        |

|  |                                     |
|--|-------------------------------------|
| <b>I Financial Aspects</b>   |                                     |
| <b>i) Fixed Capital</b>  |                                     |
| <b>a) Land and Building</b>  |                                     |
| Land area  | 20000 sq.ft                         |
| Built up area  | 15000 sq.ft                         |
| Cost of building   | Rs.100.00 lakh                      |
| <b>Total cost of building</b>                                      | Rs.100.00 lakh ( land not included) |
| <b>b) Machinery and Installation</b>                               | Rs.100.00 lakh                      |
| <b>Fixed Capital = a + b</b>                                       | Rs.200.00 lakh                      |
| <b>II Working Capital</b>  |                                     |
| a) Raw materials per month   | Rs.17.85 lakh                       |
| b) Electricity and water charges                                   | Rs.3.00 lakh                        |
| c) Man power cost(including benefit)                               | Rs.4.80 lakh                        |
| d) maintenance   | Rs.0.40 lakh                        |
| e) Misc expenses   | Rs.0.40 lakh                        |
| Total expenses per month   | Rs.26.45 lakh                       |
| Working Capital for 3 months                                       | Rs.79.35 lakh                       |
| <b>III Total Capital Investment</b>                                | = Fixed capital + Working capital   |
| <b>Total Capital Investment</b>                                    | Rs.279.35 lakh                      |
| <b>IV Financial Analysis</b>                                       |                                     |
| <b>a) Cost of production</b>                                       |                                     |
| Working capital x 4  | Rs.317.40 lakh                      |
| Depreciation of building@5%  | Rs.5.00 lakh                        |
| Depreciation of Machinery @ 10%                                    | Rs.10.00 lakh                       |
| Interest on the loan taken (80% of total capital investment @ 13%) | Rs.29.05 lakh                       |
| <b>Total cost of production</b>                                    | Rs.361.45 lakh                      |
| <b>b) Turnover per year</b>  |                                     |
| cost of production of the product                                  | Rs 1255.00                          |
| Quantity produced  | 28800                               |

|                               |  |
|-------------------------------|--|
| Selling cost of board         | Rs.50.00 per sq.ft                           |
| Total turnover                | Rs.460.80 lakhs per annum                    |
| <b>c) Net Profit per year</b> |  |
|                               | = total turnover – total cost of production. |
|                               | Rs.99.35 lakhs                               |
| <b>d) Net Profit Ratio</b>    | =net profit/turnover x 100 %                 |
|                               | <b>= 21.56%</b>                              |

### 17.3. Project for Manufacture of Wall Panel and False Ceil Composite Panels (Phenolic resin 4 mm board)

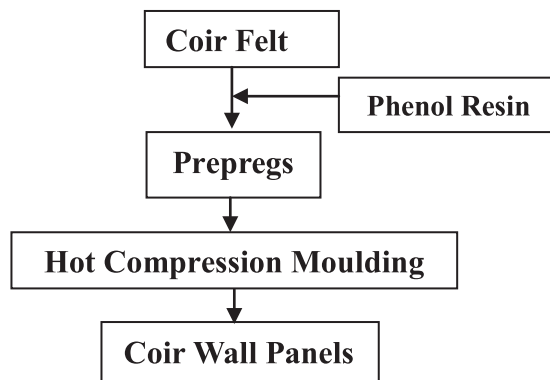
#### Highlights of Project

|   |  |
|---|--|
| Product   | Coir Wall Panels and false ceil composite panels |
| Application Area  | For wall panels and false ceil applications      |
| Size  | 24" x 24" x 4 mm                                 |
| Capacity  | 192 panels per shift                             |
| Land Requirement<br>(land cost not included in the project) | 5000 sq.ft                                       |
| Building Requirement  | 2400 sq. ft                                      |
| Raw Material  | Coir felt<br>Phenolic resin                      |
| Consumables   | Oil grease, releasing paper etc                  |
| Electricity   | 30 hp  |
| Labour requirement  | 4 persons  |
| Turnover  | Rs. 63.36 Lakhs                                  |
| Cost of machinery   | Rs.23.50 lakhs                                   |
| Cost of building  | Rs.18.00 lakhs                                   |
| Working capital<br>(3 months)                               | Rs. 9.78 lakhs                                   |

#### Manufacturing Process

Coir felt is the raw material which is procured from outside. This coir felt is first impregnated with phenol formaldehyde resin in the impregnation machine and then the excess moisture is removed from the felt by keeping it in the oven. The prepreg thus formed is then layered and then hot compressed in the panel press to form false ceil tiles or wall panels.

## Flow of Materials



## Details of Project

|                      |  |
|----------------------|--|
| Product              | Coir false ceil tile and wall panel tile |
| Size                 | 2 ft x 2 ft x 4 mm                       |
| Capacity             | 192 panels per shift                     |
| Land Requirement     | 5000 sq.ft                               |
| Building Requirement | 2400 sq. ft                              |
| Raw Material         | Coir felt<br>Phenol formaldehyde resin   |
| Consumables          | Oil grease, releasing paper etc          |
| Electricity          | 30 hp                                    |
| Labour Requirement   | 4 persons                                |

## Machineries Required

|   |   |       |       |
|---|---|-------|-------|
| 1 | Coir felt impregnation machine                                    | 1 no  | 2 hp  |
| 2 | Drier   | 1 no  | 5 hp  |
| 3 | Hot compression moulding machine two daylight with heating system | 1 no. | 20 hp |

## Cost of Machineries

|                                    |   |       |                       |
|------------------------------------|---|-------|-----------------------|
| 1                                  | Coir felt impregnation machine                                    | 1 no  | 1.50 lakhs            |
| 2                                  | Drier   | 1 no  | 3.00 lakhs            |
| 3                                  | Hot compression moulding machine two daylight with heating system | 1 no. | 15.00 lakhs           |
|                                    | Installation and other charges                                    |       | 1.50 lakhs            |
| <b>Total cost of the machinery</b> |   |       | <b>Rs.25.00 lakhs</b> |



**Production Data**

|                             |                               |
|-----------------------------|-------------------------------|
| Size of panel               | 2 ft x 2 ft x 4 mm            |
| Capacity per hour           | 24 panels per hour            |
| No of shifts                | 1                             |
| Production per day          | 192 panels                    |
| Production per annum        | 57600 panels                  |
| Rate of sheet               | Rs.110=00 per panel           |
| Working days per year       | 300 days(25 days x 12 months) |
| Total income per annum      | Rs. 63.36 lakhs               |
| Total expenditure per annum | Rs. 46.13 lakhs               |
| Profit per annum before tax | Rs. 17.23 lakhs               |

| <b>Setting up of a Manufacturing unit for Coir wall panels</b> |                                   |
|--|-----------------------------------|
| <b>Project Profile</b>   |                                   |
| <b>Production capacity per annum</b>                           |                                   |
| Production per Shift   | 192 panels per shift              |
| Production per annum   | 57600 Panels per annum            |
| Turnover   | Rs. 63.26 lakh                    |
| <b>I Financial Aspects</b>                                     |                                   |
| <b>i) Fixed Capital</b>  |                                   |
| <b>a) Land and Building</b>                                    |                                   |
| Land area  | 5000 sq.ft                        |
| Built up area  | 2400 sq.ft                        |
| Cost of building   | Rs.18.00 lakh                     |
| <b>Total cost of building</b>                                  | Rs.18.00 lakh( land not included) |
| <b>b) Machinery and Installation</b>                           | Rs.25.00 lakh                     |
| <b>Fixed Capital = a + b</b>                                   | Rs.43.00 lakh                     |
| <b>II Working Capital</b>                                      |                                   |
| a) Raw materials per month                                     | Rs.1.66 lakh                      |
| b) Electricity and water charges                               | Rs.0.50 lakh                      |
| c) Man power cost(including benefit)                           | Rs.0.50 lakh                      |

|  |  |
|--|--|
| d) maintenance   | Rs.0.30 lakh                                 |
| e) Misc expenses   | Rs.0.30 lakh                                 |
| Total expenses per month   | Rs.9.78 lakh                                 |
| Working Capital for 3 months                                       | Rs.34.78 lakh                                |
| <b>III Total Capital Investment</b>                                | = Fixed capital + Working capital            |
| <b>Total Capital Investment</b>                                    | Rs.34.78 lakh                                |
| <b>IV Financial Analysis</b>                                       |  |
| <b>a) Cost of production</b>                                       |  |
| Working capital x 4  | Rs.39.12 lakh                                |
| Depreciation of building@5%  | Rs.0.90 lakh                                 |
| Depreciation of Machinery @ 10%                                    | Rs.2.50 lakh                                 |
| Interest on the loan taken (80% of total capital investment @ 13%) | Rs.3.61 lakh                                 |
| <b>Total cost of production</b>                                    | Rs.46.13 lakh                                |
| <b>b) Turnover per year</b>  |  |
| Cost of production of the product                                  | Rs 80.08                                     |
| Quantity produced  | 57600  |
| Selling cost of board  | Rs.110.00 per piece                          |
| Total turnover   | Rs.63.36 lakhs per annum                     |
| <b>c) Net Profit per year</b>                                      |  |
|  | = total turnover – total cost of production. |
|  | Rs.17.23 lakh                                |

| <b>17.4. Setting up of a manufacturing unit for Coir needled felt – 4 ft width</b> |                       |
|--|-----------------------|
| <b>Project Profile</b>   |                       |
| <b>Production capacity per annum</b>   |                       |
| Production per day   | 1756 sq.mts per shift |
| Production per annum   | 5,26,800 sq.mts       |
| Turnover   | 94.82 lakh            |
| <b>I Financial Aspects</b>   |                       |
| <b>i) Fixed Capital</b>  |                       |

|   |  |
|---|--|
| <b>a) Land and Building</b>                     |  |
| Land area                                       | 5000 sq.ft                                   |
| Built up area                                   | 3000 sq.ft                                   |
| Cost of building                                | Rs.22.50 lakh                                |
| <b>Total cost of land and building</b>          |  |
| <b>b) Machinery and Equipments</b>              | Rs.23.00 lakh                                |
| <b>Fixed Capital = a + b</b>                    | Rs.45.50 lakh                                |
| <b>II Working Capital</b>                       |  |
| a) Raw materials per month                      | 3.16 lakh                                    |
| b) Electricity and water charges                | 0.50 lakh                                    |
| c) Man power cost(including benefit)            | 0.78 lakh                                    |
| Total expenses per month                        | 4.69 lakh                                    |
| Working capital for 3 months                    | 14.07 lakh                                   |
| <b>III Total Capital Investment</b>             | = Fixed capital + Working capital            |
| <b>Total Capital Investment</b>                 | =59.57 lakh                                  |
| <b>IV Financial Analysis</b>                    |  |
| <b>a) Cost of production</b>                    |  |
| Working capital x 4                             | 56.28 lakh                                   |
| Depreciation of building@5%                     | 1.13 lakh                                    |
| Depreciation of Machinery @ 15%                 | 2.30 lakh                                    |
| Interest on 80% of the total capital investment | 7.62 lakh                                    |
| <b>Total cost of production</b>                 | 67.33 lakh                                   |
| <b>b) Turnover per year</b>                     |  |
| Selling cost of the product                     | Rs.18 per sq.mt                              |
| Quantity produced                               | 5,26,800 sq.mt                               |
| Total turnover per year                         | 94.82 lakh                                   |
| <b>c) Net Profit per year</b>                   |  |
|   | = total turnover – total cost of production. |
|   | 27.49 lakhs                                  |

|                          |  |
|--------------------------|--|
| <b>Machinery Details</b> | Coir cleaning machine<br>Coir felt machine |
|--------------------------|--|

| <b>17.5.Setting up of a manufacturing unit for Coir gift articles</b> |  |
|---|--|
| <b>Project Profile</b>  |  |
| <b>Production capacity per annum</b>                                  |  |
| Production per day  | 160 pcs per shift                                |
| Production per annum  | 48,000 per annum                                 |
| Turnover  | 36.00 Lakh                                       |
| <b>I Financial Aspects</b>  |  |
| <b>i) Fixed Capital</b>   |  |
| <b>a) Land and Building</b>   |  |
| Land area   | 2000 sq.ft                                       |
| Built up area   | 1000 sq.ft                                       |
| Cost of building  | Rs.7.50 lakh                                     |
| <b>Total cost of land and building</b>                                |  |
| <b>b) Machinery and Equipments</b>                                    | Rs.10.00 lakh                                    |
| <b>Fixed Capital = a + b</b>  | Rs.17.50 lakh                                    |
| <b>II Working Capital</b>   |  |
| a) Raw materials per month  | 0.90 lakh  |
| b) Electricity and water charges                                      | 0.15 lakh  |
| c) Man power cost(including benefit)                                  | 0.20 lakh  |
| d) other expenses   | 0.30 lakh  |
| Total expenses per month  | 1.55 lakh  |
| Working capital for 3 months  | 4.65 lakh  |
| <b>III Total Capital Investment</b>                                   |  |
| <b>Total Capital Investment</b>                                       | = Fixed capital + Working capital<br>=22.15 lakh |
| <b>IV Financial Analysis</b>  |  |
| <b>a) Cost of production</b>  |  |
| Working capital x 4   | 18.60 lakh                                       |
| Depreciation of building@5%   | 0.37 lakh  |

|   |   |
|---|---|
| Depreciation of Machinery @ 15%                 | 1.00 lakh   |
| Interest on 80% of the total capital investment | 2.83 lakh   |
| <b>Total cost of production</b>                 | 22.80 lakh  |
| <b>b) Turnover per year</b>                     |   |
| Selling cost of the product                     | Rs.75 per pc  |
| Quantity produced                               | 48,000 sq.mt  |
| Total turnover per year                         | 36.00 lakh  |
| <b>c) Net Profit per year</b>                   |   |
|   | = total turnover – total cost of production.                        |
|   | 13.20 lakhs   |
| <b>Machinery Details</b>                        | Coir felt impregnation machine<br>Coir compression moulding machine |

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