Manual on Alleppey Coir Cluster

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WINROCK INTERNATIONAL INDIA

CONTENTS

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About BEE SME Program

As per available statistics (the 4th Census of MSME Sector), this sector employs an estimated 59.7 million persons spread over 26.1 million enterprises. It is estimated that in terms of value, MSMEs have a 40% share in total industrial output at a huge volume of producing over 8,000 value-added products. At the same time, MSMEs contribute nearly 35% share in Direct Export and 45% share in the Overall Export from the country. SMEs exist in almost all-major sectors in the Indian industry such as Food Processing, Agricultural Inputs, Chemicals & Pharmaceuticals, Electrical & Electronics, Medical & Surgical Equipment, Textiles and Garments, Gems and Jewellery, Leather and Leather Goods, Meat Products, Bioengineering, Sports goods, Plastics Products, and Computer Software.

However, despite the significant contributions made to towards various aspects of the nation's socio-economic scenario, this sector too faces several critical issues that require immediate attention. One such factor that falls in the ambit of this publication is the prevalence of age old technologies across the sectors and inherent inefficiencies associated with resource utilization, including, energy. The National Mission for Enhanced Energy Efficiency in Industry under the National Action Plan for Climate Change (released by Government of India on June 30, 2008) has emphasized the need for improving Energy Efficiency (EE) in the manufacturing sector. A number of sector-specific studies have also unanimously confirmed that energy intensity in the industry can be reduced with the widespread adoption of proven and commercially available technologies which will improve EE and produce global benefits from reduced Green House Gases (GHGs) emissions.

As a result of increasing awareness towards efficient usage of energy and other resources, there has been a visible reduction in energy intensity in comprehensive Indian industrial sector. However, focusing the observation on the MSME sector reveals that the energy intensity per unit of production is much higher than that of the organized large scale sector. Since energy cost is significant contributor to the overall production cost of SMEs due to high and rising energy costs in current scenarios, it is required to increase the Energy Efficiency (EE) levels in order to ensure the sustenance of SMEs. One of the ways to reduce the inefficiencies is by replacing the conventional/old/obsolete technology with feasible and adaptable energy efficient technologies. This would not only contribute towards reduction in production cost, but would also improve the quality and productivity of MSME products. However, while knowing the way out, there are still numerous barriers (as listed below) and market failures that have prevented widespread adoption of new energy efficient technologies.

The key barriers in promotion and adoption of EE technologies in Indian SME sector are as below:

- Lack of awareness and capability on the part of SMEs to take up energy conservation activities
- Lack of scientific approach on monitoring and verification of performance assessment of installed equipments and utilities.
- Non availability of benchmark data for various equipments/process
- Low credibility of the service providers such as equipment suppliers and their technologies
- The SME owners are more concerned on production and quality rather than energy efficiency and conservation
- The key technical personnel employed in the SME units are based on their past experience in similar industries rather than technically qualified personnel and hence, they are not aware of the latest technologies or measures which improve energy efficiency
- Lower priority to invest in improving efficiency than in expansion (this may be due to lack of knowledge on cost benefit)

Majority of SMEs are typically run by entrepreneurs and are leanly staffed with trained technical and managerial persons to deploy and capture energy efficiency practice to reduce manufacturing cost and increase competitive edge. Therefore, it will be useful to build energy efficiency awareness in the SMEs by funding/ subsidizing need based studies in large number units in the SMEs and giving energy conservation recommendations including short term energy conservation opportunities, retrofit/ replacement options and technology up-gradation opportunities.

In this context, the Bureau of Energy Efficiency (BEE) has laid adequate emphasis on the SME sector as presented in the Working Group on Power for 11th Five-Year Plan (2007-2012)-Sub-Group 5. Consequently, the Bureau has initiated the Energy Efficiency Improvement program in 29 SME clusters in India.

1.1 Program Objectives

The BEE SME Program is aimed to improve Energy Efficiency in SME sector by technological interventions in the various clusters of India. Energy Efficiency in SMEs is intended to be enhanced by helping these industries in the 29 energy intensive SME clusters of India by:

- Technology interventions

- Sustaining the steps for successful implementation of EE measures and projects in clusters
- Capacity building for improved financial planning for SME entrepreneurs.

The program also aims at creating a platform for:

- Dissemination of the best practices and the best available technologies available in the market for energy efficiency and conservation,
- Creating awareness in the clusters, and
- To demonstration the new technology interventions/ projects to stimulate adoption of similar technology/ projects in the clusters.

The BEE SME program has been designed in such a way so as to address the specific needs of the industries in the SME sector for EE improvement and to overcome the common barriers in way of implementation of EE technologies in cluster through knowledge sharing, capacity building and development of innovative financing mechanisms. Major activities in the BEE SME program are listed below:

- Energy use and technology studies
- Capacity building of stake holders in cluster for building EE projects
- Implementation of energy efficiency measures
- Facilitation of Innovative financing mechanisms for implementation of energy efficiency projects

The brief objective of each of these activities is presented below:

- **Energy Use and Technology Studies**

An in-depth assessment of the various production processes, energy consumption pattern, technology employed and possible energy conservation potential and operational practices in cluster by means of conducting detailed energy audits and technological gap assessment studies in a cluster is presented herewith. The energy audit study includes analysis of the overall energy consumption pattern, study of production process, identification of energy intensive steps/sub-processes and associated technology gap assessment for the individual units. The study also focuses on identifying the Best Operating Practices and the EE measures already implemented in the units.

- **Capacity Building of Stakeholders**

The aim of this activity is capacity building of the enrolled LSPs to equip them with the capability to carry on the implementation of the EE technology projects in cluster on a

sustainable basis. The needs of the LSPs will be identified as a preparatory exercise to this activity, as to what they expect from the BEE Program in terms of technical and managerial capacity building.

- **Implementation of EE Measures**

To implement the EE and technology up-gradation projects in the clusters, technology specific Detailed Project Reports (DPRs) for five different technologies for three scales of operation will be prepared. The DPRs will primarily address the following:

- ✓ Comparison of existing technology with feasible and available EE technology
- ✓ Energy, economic, environmental & social benefits of proposed technology as compared to conventional technology
- ✓ Details of technology and service providers of proposed technology
- ✓ Availability of proposed technology in local market
- ✓ Action plan for implementation of identified energy conservation measures
- ✓ Detailed financial feasibility analysis of proposed technology

- **Facilitation of Innovative Financing Mechanisms**

Research and develop innovative and effective financing mechanisms for easy financing of EE measures in the SME units in the cluster. The easy financing involves following three aspects:

- ✓ Ease in financing procedure
- ✓ Availability of finance on comparatively easy terms and relaxed interest rates
- ✓ Compatibility and availing various other Central/ State Governments' incentive schemes like CLCSS, TUFF etc.

1.2 Expected Project Outcome

Expected project outcome of BEE SME program in clusters are:

- **Energy Use and Technology Analysis**

The outcome of the activity will include identification of the EE measures, potential of renewable energy usage, fuel switching, feasibility analysis of various options, and cost benefit analysis of various energy conservation measures including evaluation of financial returns in form of payback period, IRR and cash flows. The cost liability of each measure, including the capital and operational cost will also be indicated.

The identified EE measures will be categorized as per the following types:

- ✓ Simple housekeeping measures/ low cost measures
- ✓ Capital intensive technologies requiring major investment.

The sources of technology for each of the suitable low cost and high cost measures, including international suppliers as well as local service providers (LSPs)/ technology suppliers, in required numbers shall be identified. It is envisaged to create a knowledge bank of detailed company profile and CVs of key personnel of these technology sources. The knowledge bank will also include the capability statements of each of these sources.

The EE measures identified in the energy audit study will be prioritized as per their energy saving potential and financial feasibility. The inventorization survey would establish details like the cluster location, details of units, production capacity, technologies employed, product range, energy conservation potential along with possible identified EE measures and respective technology suppliers.

The specific outcomes of this activity will be as follows:

- ✓ Determination of energy usage and energy consumption pattern
- ✓ Identification of EE measures for the units in cluster
- ✓ Development and preparation of case studies for already implemented EE measures and Best Operating Practices in the units
- ✓ Evaluation of technical & financial feasibility of EE measures in terms of payback period, IRR and cash flows.
- ✓ Enlisting of Local Service Providers (LSPs) for capacity building & training including creation of knowledge bank of such technology suppliers
- ✓ Capacity building modules for LSPs
- ✓ Development and preparation of cluster manuals consisting of cluster details and EE measures identified in cluster.

- **Implementation of EE Measures**

The aim of this activity is development and finalization of bankable DPRs for each of the EE projects which would presented before the SME units for facilitation of institutional financing for undertaking the EE projects in their respective units.

The activity will ensure that there is close match between the proposed EE projects and the specific expertise of the Local Service Providers (LSPs). These DPRs will be prepared for EE, renewable energy, fuel switching and other possible proposed measures during course of previous activities. Each DPR will include the technology assessment, financial assessment, economic assessment and sustainability assessment

of the EE project for which it has been developed. The technology assessment will include the details of the design of equipment/ technology along with the calculation of energy savings. The design details of the technology for EE project will include detailed engineering drawing for the most commonly prevalent operational scale, required civil and structural work, system modification and included instrumentation and various line diagrams. The LSPs will be required to report the progress of the implementation of each such project to BEE PMC. Such implementation activities can be undertaken by the LSPs either solely or as a group of several LSPs.

- **Capacity Building of LSP's and Bankers**

The outcome of this activity would be training and capacity building of LSPs so as to equip them with necessary capacity to undertake the implementation of proposed EE projects as per the DPRs. Various training programs, training modules and literature are proposed to be used for the said activity. However, first it is important to ascertain the needs of the LSPs engaged, as in what they expect from the program in terms of technical and managerial capacity building. Another outcome of this activity will be enhanced capacity of banking officers in the lead banks in the cluster for technological and financial feasibility analysis of EE projects that are proposed by the SME units in the cluster. This activity is intended to help bankers in understanding the importance of financing energy efficiency projects, type and size of projects and ways and means to tap huge potential in this area. Different financing models would be explained through the case studies to expose the bankers on the financial viability of energy efficiency projects and how it would expand their own business in today's competitive environment.

- **Concluding Workshop**

The outcome of this activity will be the assessment of the impact of the project as well as development of a roadmap for future activities. The workshop will be conducted for the representatives of the local industrial units, industry associations, LSPs and other stakeholders so that the experiences gained during the course of project activities including implementation activities of EE project can be shared. All the stakeholders in the project will share their experience relating to projects undertaken by them as per their respective roles. Effort from industrial units as well as LSPs to quantify energy savings thus achieved would be encouraged. This would lead to development of a roadmap for implementing similar programs in other clusters with greater efficiency and reach.

1.3 Identified Clusters under the Program & Target Cluster for Implementation

29 most energy intensive MSME clusters across different end use sectors have been identified to implement the BEE SME program for EE improvement. The details of industrial sector and identified cluster are provided in Table 1 below:

Table 1: List of Clusters Identified for BEE SME Program

S. No.	Cluster Name	Location
1.	Oil Milling	Alwar; Rajasthan
2.	Machine Tools	Bangalore; Karnataka
3.	Ice Making	Bhimavaram; Andhra Pradesh
4.	Brass	Bhubaneswar; Orissa
5.	Sea food processing	Kochi, Kerala
6.	Refractories	East &West Godavari, Andhra Pradesh
7.	Rice Milling	Ganjam, Orissa
8.	Dairy	Gujarat
9.	Galvanizing	Howrah, West Bengal
10.	Brass& Aluminum	Jagadhari, Haryana
11.	Limestone	Jodhpur, Rajasthan
12.	Tea processing	Jorhat, Assam
13.	Foundry	Batala, Jalandhar & Ludhiana, Punjab
14.	Paper	Muzzafarnagar, Uttar Pradesh
15.	Sponge iron	Orissa
16.	Chemicals & Dyes	Vapi, Gujarat
17.	Brick	Varanasi, Uttar Pradesh
18.	Rice Milling	Vellore, Tamil Nadu
19.	Chemical	Ahmedabad, Gujarat
20.	Brass	Jamnagar, Gujarat
21.	Textile	Pali, Rajasthan
22.	Textile	Tirupur, Tamil Nadu
23.	Tiles	Morbi, Gujarat
24.	Textile	Solapur, Maharashtra
25.	Rice Milling	Warangal, Andhra Pradesh
26.	Tiles cluster	Mangalore, Karnataka
27.	Textile cluster	Surat, Gujarat
28.	Coir cluster	Alleppey, Kerala
29.	Glass cluster	Firozabad, Uttar Pradesh

As a part of BEE SME program, one of cluster identified was the Alleppey Coir cluster. It was proposed to carry out energy use and technology audit studies in 60 units in the Alleppey Coir cluster covering all types and sizes of the industries to understand/give valuable insight into the process of developing energy efficiency solutions relevant to the SME industries in the Alleppey Coir cluster.

2.3 Overview of Alleppey SME Cluster

2.3 Cluster Background

The coir industry remains as traditional industry with a thrust on the skill of the workers. The major segments of the coir industry are spinning, weaving and marketing. In the early period of last century there was a boom in the coir sector after the introduction of factory culture but the post independence period witnessed several structural changes that had affected the performance of coir sector adversely. One of the fallout of this phenomenon was the entry of exporters and depots in the sector that actually funded the activities. This had also resulted in the exploitation of traditional workers causing strained labour relationship in the industry. However, the industry kept going due to the presence of small producers providing employment to the thousands of skilled craftsmen. Spinning and weaving remained largely as household activities and the downstream operations functioned in the organized sector. Of late, spinning and weaving has also come under the fold of factory working, to a great extent.

The coir industry was mainly concentrated in and around Alappuzha Town. During the post-independence period nearly a dozen of large scale units sprung up and were doing significant business. In the early seventies the units faced excessive trade union activities that gradually led to fragmentation of the industry. In this process the industrialists became merely exporters, sourcing products from small entrepreneurs. These structural changes adversely affected the health of the industry as a whole leading to un-remunerative prices at all stages. Intervention by the Government and regulating agencies could mitigate the problems to a limited extent only.

During the nineties, while the industry registered reasonable growth the availability of husk got reduced due to a combination of factors. This gradually led to a situation of shortage of fiber and the industry started depending on fiber brought from neighboring states. Today nearly fifty percent of the requirement of fiber in Kerala is brought from Tamilnadu.

Coir products are made from fiber from the husks of coconuts, using for the most part production techniques that barely changed in the past century. Traditional products have mainly revolved around the production of mats and matting:

- ✓ **Mats:** Largely door mats, mats are made from a mix of coir yarn (as the base) and rough fibers (as bristles).
- ✓ **Matting:** Woven matting from coir yarn is done on handlooms and used in interiors of houses, commercial spaces, and ships. Semi-automated and fully-automated (or 'power') looms have been more recently introduced.

Traditionally a cottage industry, the coir sector has more recently been undergoing substantial changes as more capital intensive products are coming on-line. Non-coir inputs are also increasingly being used, with coir accounting for only 60% of the total product. New products include:

- ✓ **Geo-textiles:** Similar to coir matting, geo-textiles have a looser weave and are used outside for erosion control ('pre-vegetative protection').
- ✓ **Rubberized Coir:** Using another important Kerala commodity, 'rubberized' products include products that combine coir and rubber (such as a coir mat with a rubber trim or backing) or blend the coir fibre itself with rubber (such as coir-rubber composites for car seat stuffing).
- ✓ **PVC Mats:** One of the latest changes in coir production, PVC mats are made from coir fibre brushes adhered onto PVC base (or 'seat').
- ✓ **Mixed Products:** The Alappuzha floor-coverings cluster is increasingly incorporating non-coir inputs into its products. Apart from rubber and PVC as raw materials, jute, sisal and cotton are also the raw materials used.
- ✓ Units in the cluster are involved in various activities of the production process as mentioned in Table 2.

Table 2: Details of the Units Involved in Various Activities

S. No	Type of Industry/Activity	No. of Industries
1	Spinning	8
2	Dyeing	15
3	PVC Tufted Coir Products	7
4	Handlooms/ Fiber mats	210
5	Coir Matting's/ Rugs	182
6	Rubberized Coir products	29
	Total	**451**

2.1.2 Product Manufactured

Many coir production processes have not changed in over a century. However, increased mechanization is happening, particularly with regard to fiber extraction and weaving. The products manufactured in cluster units are:

- ✓ Mats (Rod mats (Brush mats), Fiber mat, Creel mat, Bit mat, Cord, Cable or ribbed mats)
- ✓ Matting
- ✓ Matting rugs
- ✓ Carpets

- ✓ Rubberized coir products
- ✓ Others (Ropes, Screens, Acoustic ceiling, Rubberized coir mattresses, Acoustical back panels)

2.1.3 Classification of Units

Coir works units in Alleppey are classified based on the type of operation of the units and as well as production capacity.

2.1.3.1 Type of operation

Coir units in Alleppey Coir cluster are engaged in eight different types of operations, namely:

- ✓ Husk Collection
- ✓ Retting
- ✓ De-fibering
- ✓ Spinning
- ✓ Weaving
- ✓ Dyeing
- ✓ Product Manufacturing
- ✓ Packing and Shipping

The percentage distribution of different types of Coir units in Alleppey cluster is furnished in Figure 1.

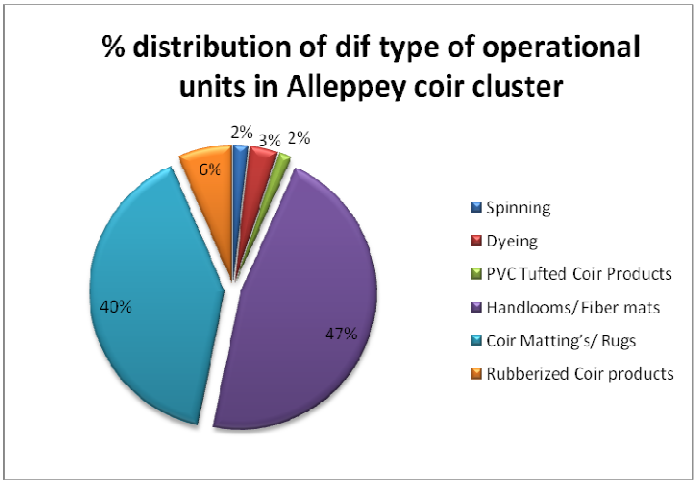


Figure 1: Distribution of units by type of operation

2.1.3.2 Production Capacity

Coir units in Alleppey are classified based on production capacity for each activity. Table 3 shows the classification of units based on production capacity.

Table 3: Classification of Coir units based on production capacity

S. No.	Activity	No. of units	Production Range
1	Spinning	8	3000-6000 tons/ year
2	Dyeing	15	1000-10000 tons/ year
3	PVC Tufted Coir Products	7	50-105 lakh m^2/ year
4	Handlooms/ Fiber mats	210	30-50 lakh m^2/ year
5	Coir Matting's/ Rugs	182	50-150 lakh m^2/ year
6	Rubberized Coir products	29	100-150 lakh m^2/ year

2.1.4 Annual Energy Bill

Annual energy bill of the units depends upon the size of the plant and type of activity of the units. Table 4 and Figure 2 show the classification of units based on energy bill of the units.

Table 4: Distribution of units based on annual energy bill

S. No	Annual Energy Bill (Rs in lakhs)	No of units	Percentage %
1.	Less than 0.10	300	66
2.	Below 50	105	23
3.	50 to 100	42	9
4.	Above 100	7	2

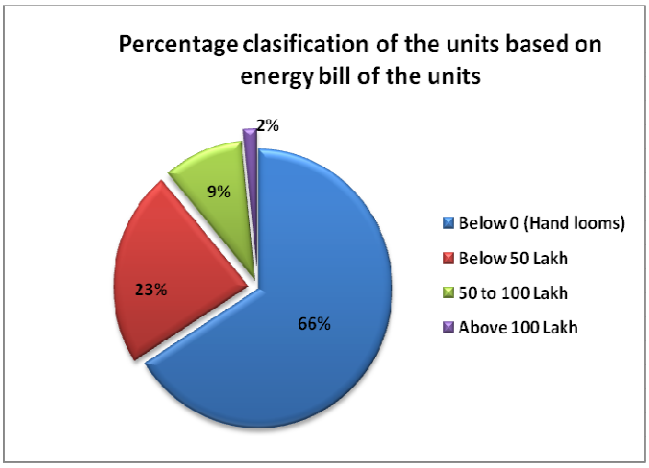
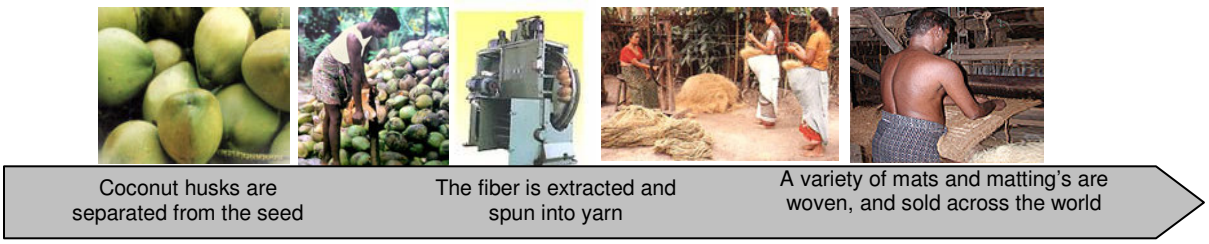


Figure 2

2.1.5 Raw Materials Used

The process begins with the coconut being stripped of its hard outside layer skin and 2-3 inch intermediate layer of fibrous pulp, the husk. Fibers from the husk form coir. Extracting the fibers initially requires that the husk is broken down through a process of 'retting'. This is a curing process, during which the husk partially decomposes, allowing it to be separated into coir fibers and a residue called coir pith. This process earlier used to take 6 to 9 months, but now-a-days it's accomplished within less than 10 days. The fibers are then separated through beating by either manually or mechanically. More than 95% of the fibers are separated through mechanical process. The fiber is then spun into yarn, using manual labor intensive techniques that have experienced little mechanization in Alappuzha. The yarn and raw fibers are then bleached or dyed (if necessary) and used to make both mats and matting. These are usually woven on hand-operated looms, though recent years have witnessed increased automation. The final coir products are then sold in both domestic and international markets.

There are two main types of coir fiber: brown coir, from fully ripened coconut husks; strong and resistant to abrasion, it is used in brushes, floor mats, and upholstery padding; white coir, from husks of coconuts harvested just before they ripen; softer and less strong, it is spun into yarn, used for ropes and mats.



2.2 Energy Situation in the Cluster

Major energy sources being used in the Alleppey Coir cluster are electricity and fuels such as firewood, Furnace Oil, HSD, and Coconut husk. The coir units in the cluster

require both electrical and thermal energy except for handlooms which uses only electrical energy. The fuel is used for generation of heat (thermal energy) in thermic fluid heaters, boilers, and chulhas. Electrical energy is used for the operation of electrical utilities like blowers, pumps, air compressors, and machine drives.

2.2.1 Type of fuels used in Alleppey Coir cluster

Details of fuels used and prevailing market prices of various forms of energy in Alleppey Coir cluster is presented in table 5 below:

Table 5: Details of fuels used in cluster and its prices

S. No	Name of fuel	Cost of fuel (Rs) per unit	Units	Gross Calorific Value (kcal/kg)
1	Firewood	3.00	Kg	3800
2	Coconut husk	2.00	Kg	4000
3	Furnace oil	35.00	Liter	9300
4	High Speed Diesel	42.00	Kg	10000

2.2.2 Energy consumption

Energy consumption (thermal & electrical energy) in coir unit depends on type of unit and products manufactured. Annual electrical energy and thermal energy consumption in typical coir dyeing, PVC tufting, spinning, weaving, rubberized coir products units is presented in tables below:

Table 6: Annual Energy Consumption of Dyeing Units

Details	Unit 1 (450 TPA)	Unit 3 (400 TPA)
Annual electricity consumption • kWh / year • Lakh kCal / year	 4,42,920 3,809	 2,94,804 2,535
Annual fuel consumption • Liters / year • Lakh kCal / year	 3,71,250 37,125	 2,01,600 20,160
Total annual energy consumption • Lakh kCal / year • Tons of Oil Equivalent (ToE)	 40,934 409	 22,695 227

Table 7: Annual Energy Consumption of PVC Tufting Units

Details	Unit 1 (14.2 sq.m. PA)	Unit 2 (16.5 sq.m. PA)
Annual electricity consumption • kWh / year • Lakh kCal / year	 1,99,395 1,715	 3,29,838 2,837
Annual fuel consumption • Liters / year • Lakh kCal / year	 1,37,500 12,787	 2,75,000 25,575
Total annual energy consumption • Lakh kCal / year • Tons of Oil Equivalent (ToE)	 15,465 155	 30,337 303

Table 8: Annual Energy Consumption of Weaving (Matting) Units

Details	Unit 1 (3.02 lakh of sq.m. PA)
Annual electricity consumption • kWh / year • Lakh kCal / year	 29,438 253
Annual thermal energy consumption	nil
Total annual energy consumption • Lakh kCal / year • Tons of Oil Equivalent (ToE)	 253 3

Table 9: Annual Energy Consumption of Rubberized Coir Mat Units

Details	Unit 1 (lakh 1.20 mats/annum)	Unit 2 (lakh 2.10 mats/annum)	Unit 3 (lakh 2.80 mats/annum)
Annual electricity consumption • kWh / year • Lakh kCal / year	 10,800 93	 12,000 103	 24,000 206
Annual thermal energy consumption	nil	nil	nil
Total annual energy consumption • Lakh kCal / year • Tons of Oil Equivalent (ToE)	 93 1	 103 1	 206 2.1

Annual energy consumption of units is summarized and presented below:

Table 10: Annual Energy Consumption in Different Type of Units in Alleppey Coir Cluster

S.No	Type of Unit	Energy Consumption (MTOE)	Total nos. of Units	Total Energy Consumption (MTOE)
1	**Dyeing**	409	15	6135
2	**PVC Tufting Units**	303	7	2121
3	**Mattings (Power Looms)**	6	40	240
4	**Rubberized Coir mats**	2.1	29	61
	Total	**720**	**91**	**8557**

Total annual energy consumption of Allappey Coir cluster is approximately 8,557 MTOE (Metric Tonne of oil equivalent). Percentage of total energy consumption in different types of units in the cluster is presented in Figure 3 below.

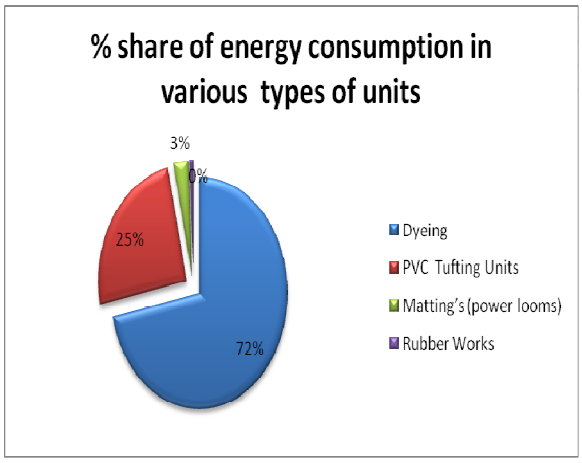


Figure 3: Percentage share of energy consumption by different type of units

2.2.3 Specific Energy Consumption

The specific energy consumption for different types of units of the cluster like dyeing, PVC Tufting, mattings, and rubber works is furnished below in Table 11.

Table 11: Specific Energy Consumption

Type of Unit	Specific Power Consumption	Specific Fuel Consumption	Electricity Cost (per kg)	Thermal Energy Cost per kg (Rs./kg)	Specific Energy Cost (per kg)
Dyeing	0.15	1.6	0.73	4.67	5.40
PVC Tufting Units	0.19	0.16	0.95	5.6	6.55
Mattings (Power Looms)	2.64	--	13.2	--	13.2
Rubber Works	0.14	--	0.7	--	0.7

2.3 Manufacturing Process

The production process used by Alleppey Coir units is captured based on the braod production process adopted, the production process are Weaving, Dyeing, PVC Tufting, Stenciling, Finishing, and Rubber work. The process adopted is almost similar in all cluster units. However, depending upon the final product, quality of final product and raw material properties; the production process may be altered to suit the requirements.

2.3.1 Handloom Weaving

The raw coir fiber is purchased from the market through agents. The raw fiber is then processed for disintegration and to remove dust particles and other foreign particles / materials and then the clean fiber is taken for handloom weaving process. The weaving process is carried out by manually operated handloom to produce mats. The manual handloom requires two persons, one person operates the handloom, and other person feeds the raw coir into the handloom. After weaving process completion the coir mats produced are cut manually into the required size. The manually cut sized mats are passed on to other near by units for finishing and stenciling (designing).

The production process employed for fabric weaving by handloom is shown below in Figure 4:

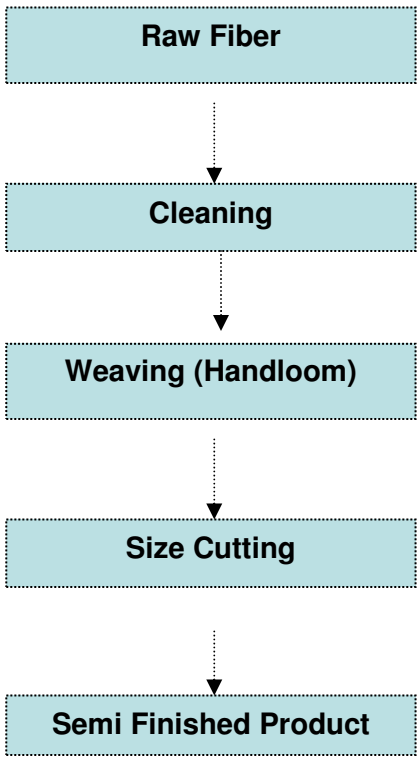


Figure 4: Process Flow Diagram of Fiber Mats

2.3.2 Dyeing

Coir yarn is first bleached by soaking into hot water and bleaching agents (chemical). The hot water is generated by using conventional chulha. After bleaching, dyeing process of the coir yarn is carried out to colors the coir year as per the design requirements. After completion of dyeing process, water is removed for coir yarn through centrifuges action and then dried in natural sunlight for removing moisture content. The dyed and dried yarn is wounded on bobbins in the spooling machines and is taken to warping machine and finally coir yarn is processed in power loom to produce coir mattings.

The process employed for fabric dyeing is shown below in Figure 5:

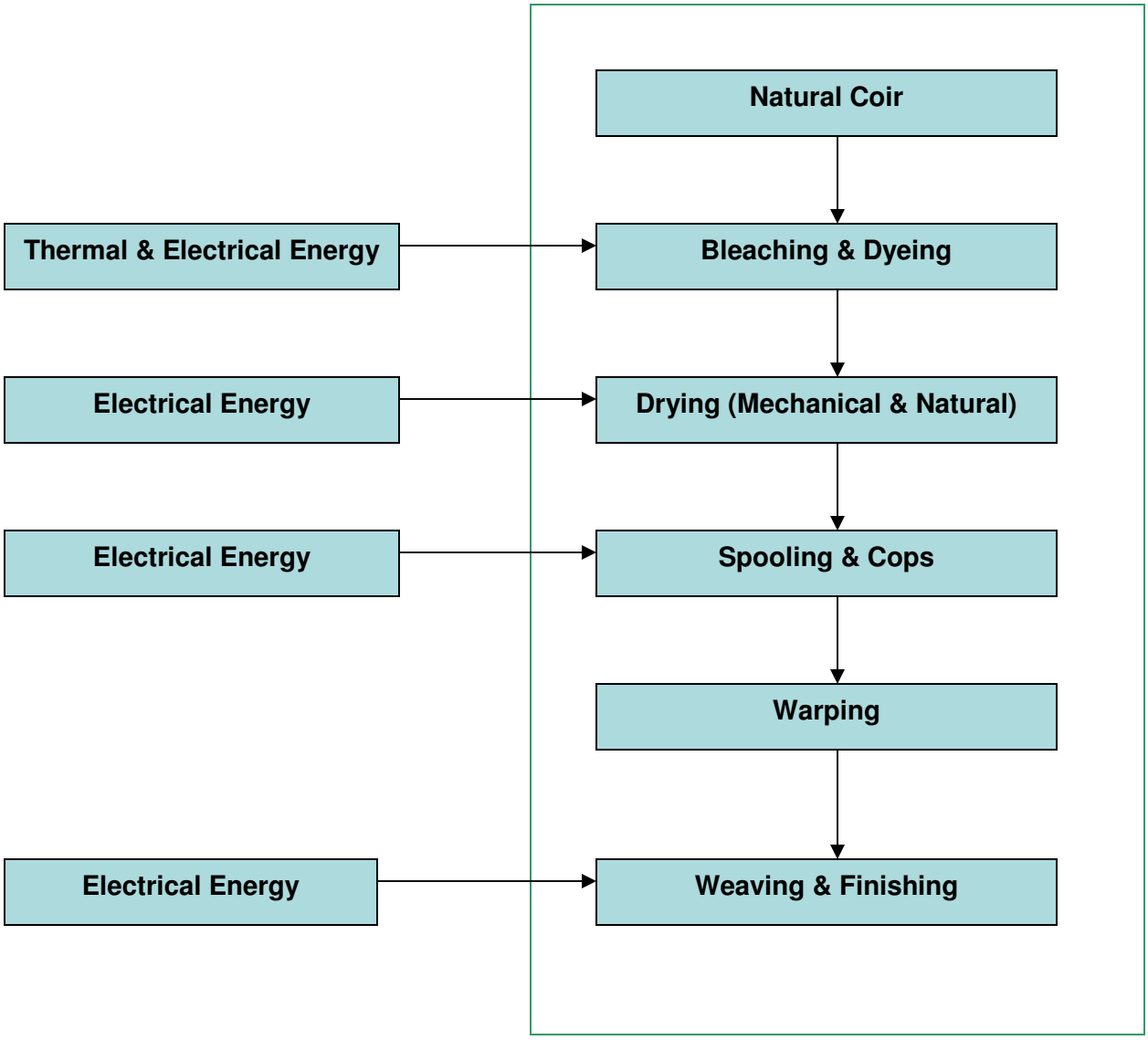


Figure 5: Process flow diagram of the Coir mattings

2.3.3 Stenciling

The stenciling units are of small sized units and normally do stenciling on job work basis. Raw material for stenciling used is semi finished coir mats. Initially, the coir mats are processed in shearing machines for smooth surface finish. The design pattern is placed on the coir mat and colors are sprayed on the pattern, the design is embossed on the surface of the coir mat. Compressed air is used for color spraying. After completion of the stenciling process, the coir mats are dried on natural sunlight and finished manually to remove unwanted materials on the coir mat and is delivered to the customers.

The manufacturing process of stenciling process is shown below Figure 6.

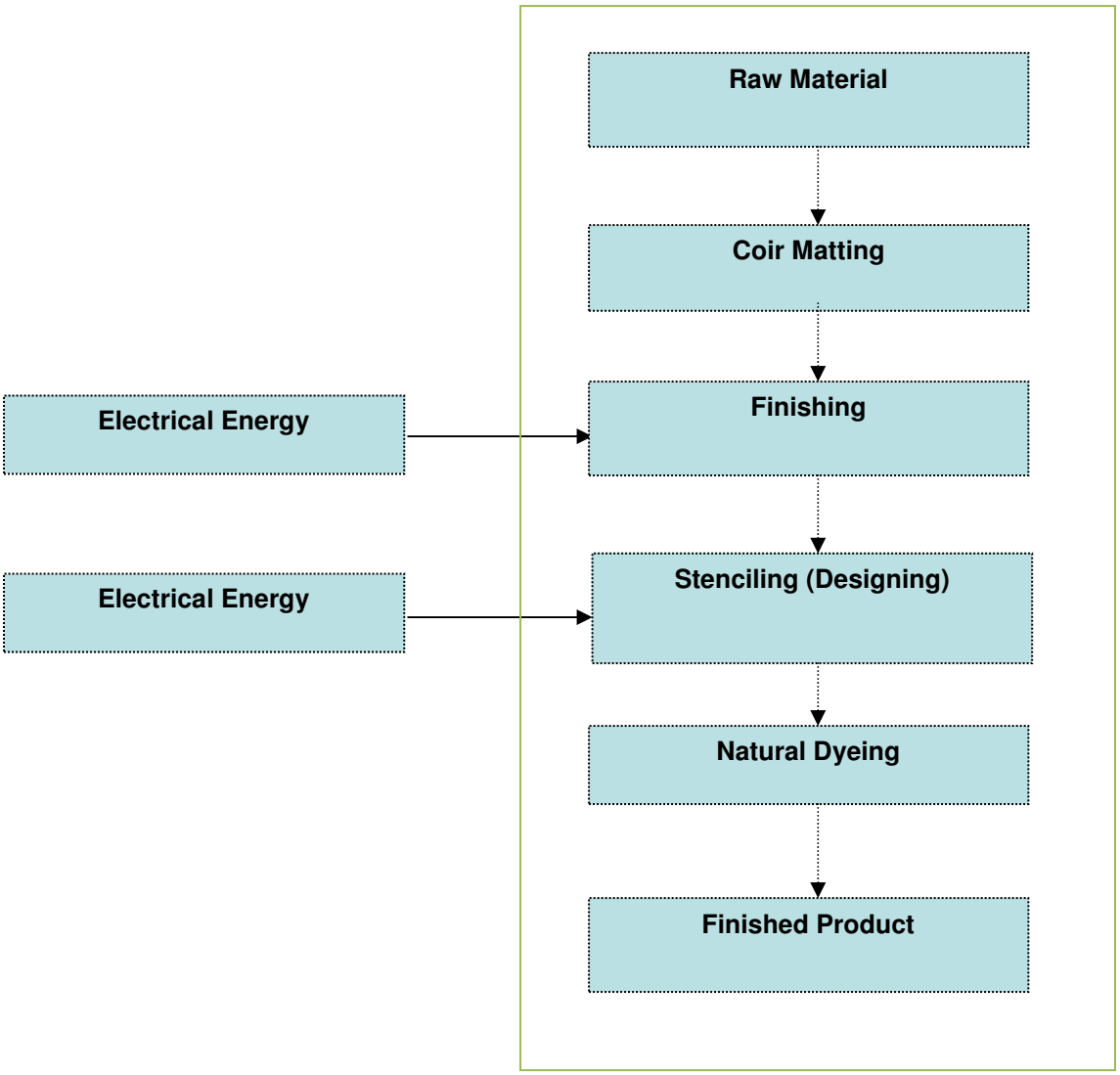


Figure 6: Process flow diagram of Stenciling

2.3.4 Rubber Products

Coir matting is purchased from the open market and manually cut to the required sizes of 2 to 3 feet. Rubber, clay, sulphur, TMT and rubber contained oil are mixed in the required proportions and the mixture is mixed vigorously in the mixing mill. Then the rubber compound is processed in the calendaring machine for making rubber sheets. The rubber sheets are cut into the required sizes as per the required size and are bonded with coir mats at the bottom side and kept on a plate. The plate is pressed in hot press, where the temperature of 80 oC is maintained by electrical heater and pressed with the hydraulic press and the final product is packed for sale.

The manufacturing process of rubber coir mats involves the following steps as furnished below in Figure 7.

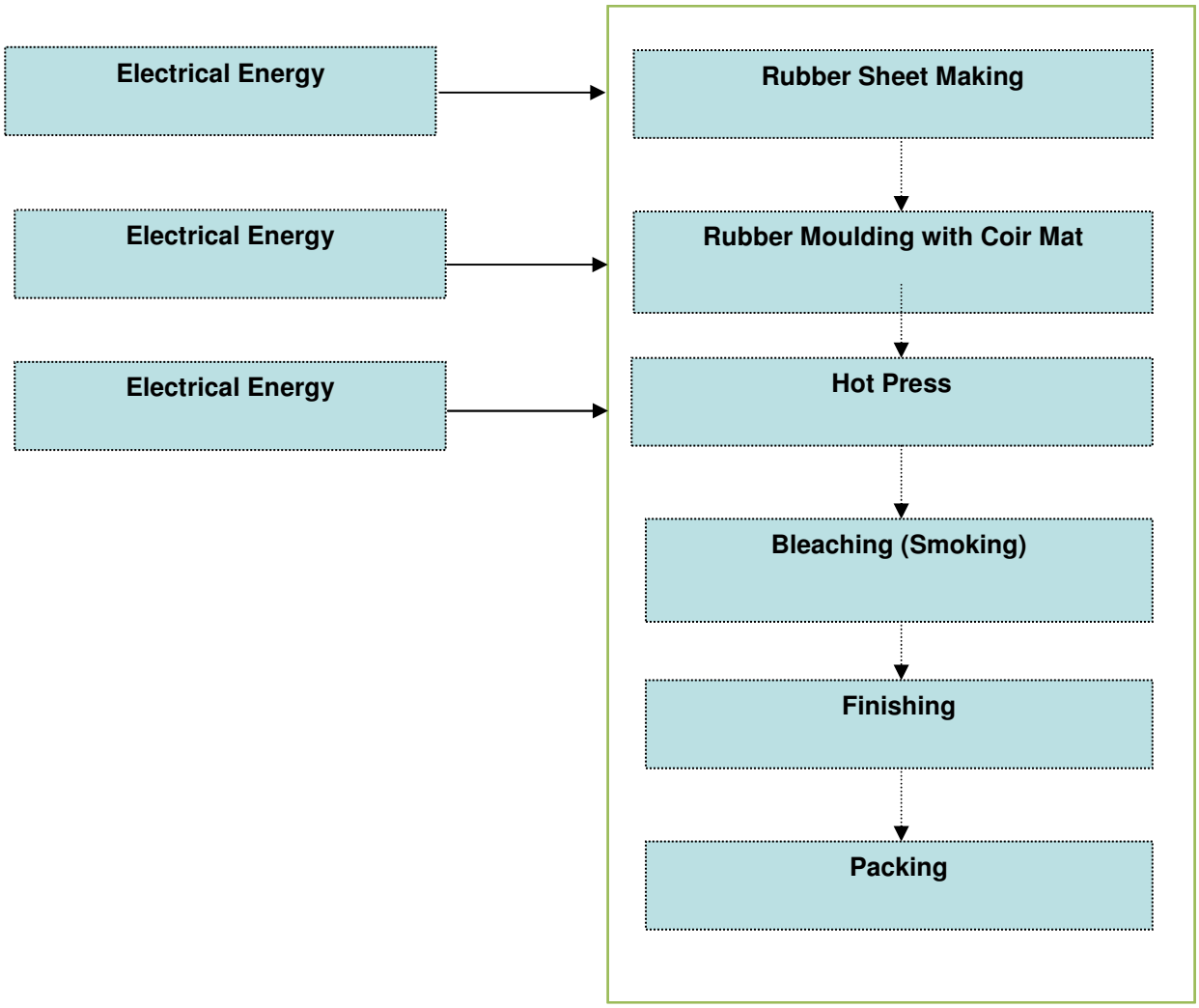


Figure 7: Process flow diagram of the rubber coir manufacturing

2.3.5 PVC Tufted Products

Poly Vinyl Chloride (PVC), DOP and other raw materials are mixed in the mixing machine for about one hour with continuous stirring till the mixture is converted into liquid form. The PVC liquid is pumped to PVC tufting machine, where the PVC liquid is spreaded on bed. The coir yarn pieces are tufted on the PVC liquid of the required size. Then the PVC mats are heated at heating panels for perfect bonding of PVC and coir pieces. The finished PVC mat passed through shearing machine to cut the unwanted parts and then cut to the required sizes in cutting machines and cross cut machines. The required size PVC mats are taken to printing section for making designs on the mats.

The manufacturing process of coir matting involves the following stages as shown in Process flow diagram in below Figure 8.

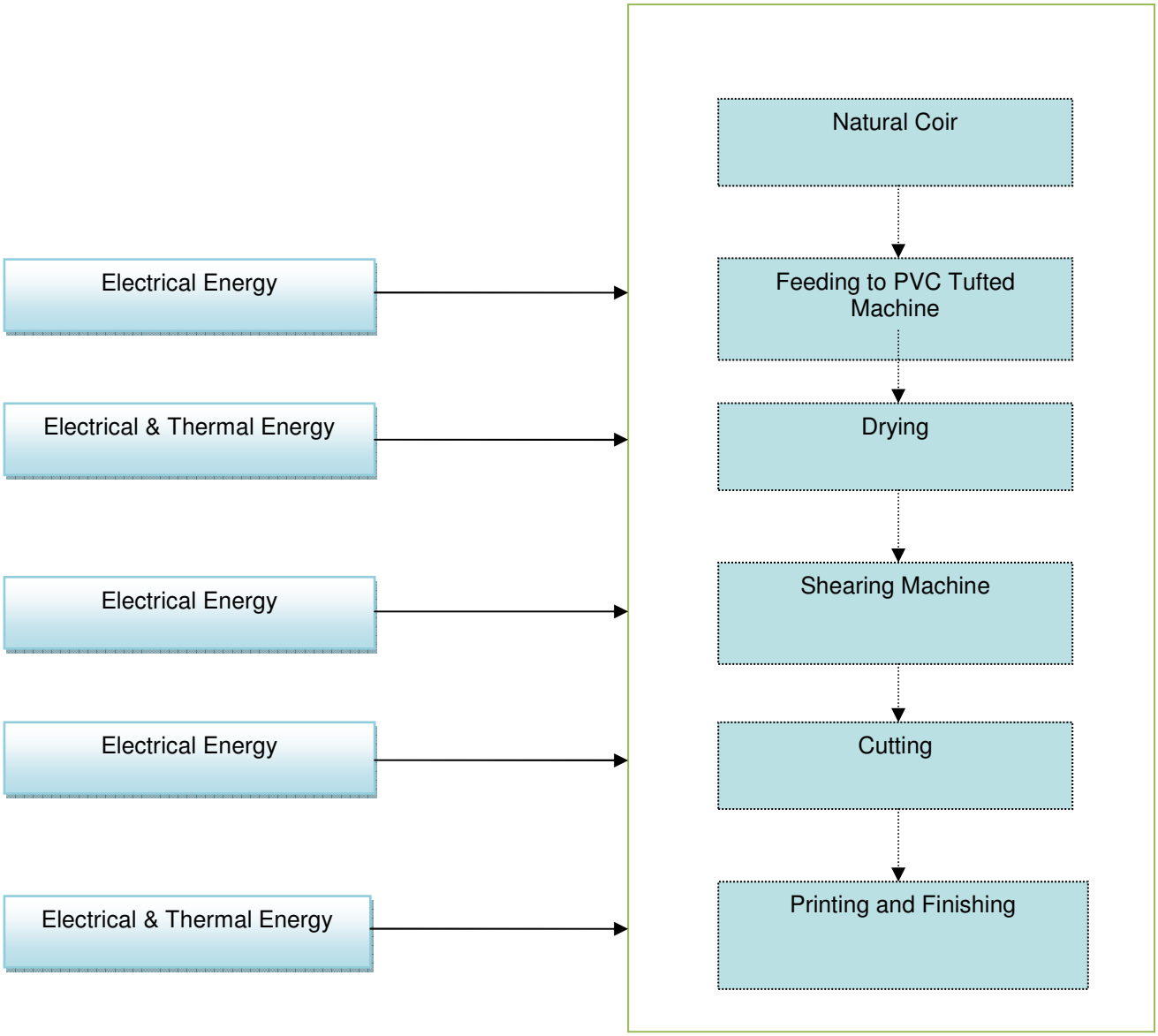


Figure 8: Process flow diagram of the PVC mats

2.4 Current Policies and Initiatives of Local Bodies

There does not exit any policies of local bodies / authorities to address energy conservation issues and install energy efficiency projects. As per the EC Act – 2001, SDA has notified to conduct mandatory energy audit for industries having above 500 kVA as contract maximum demand by empanelled consultant of SDA.

2.5 Major Barriers for Implementation of Energy Efficiency

2.5.1 Technological Issues

The processes to do with technology and innovations in SMEs are different from those that take place in large firm context. Technology in the SME sector has an increasingly complex or combinative character, most of the SMEs units in cluster are regarded for

their labour intensive and the capability work with local resources. In the past, SME entrepreneurs have given less emphasis to technology in order to reduce initial investment cost of plant /machinery. Major barriers in technology up-gradation in the cluster are:

- ✓ Lack of awareness on energy efficiency
- ✓ Lack of organizational commitment
- ✓ Narrow focus on energy
- ✓ Not clear about their existing level of operations and efficiency, due to lack of instrumentation & non availability of energy consumption data
- ✓ Limited manpower
- ✓ Cost of energy conservation options
- ✓ Orthodox mind set of entrepreneurs
- ✓ Non availability of clean fuels

2.5.2 Lack of Technical Know-How & Organizational Capacity

Majority of the coir unit owners do not have in-depth technical expertise, knowledge, or training about energy efficiency, and are dependent totally on local technology suppliers or service companies, who normally rely on established and commonly used technology. The lack of technical know-how made it impossible for the Coir unit owners to identify the most effective technical measures. Though, some of the SME owners are interested in implementing energy efficiency measures, the lack of knowledge and technical know-how, made them to depend on the local suppliers. These identified barriers however can be overcome by motivating them to attend awareness programs and detailed report on the benefits of the measures identified and cost benefit analysis. Further, sourcing of expertise on maintenance service provider or training by the equipment supplier will definitely overcome the barriers.

2.5.3 Financial Issues

About 20% of the units in the cluster have financial strength and are implementing various energy efficiency measures / projects and modern equipment. About 80% of the units in the cluster do not have adequate financial strength to implement the identified EE measures and latest equipments/machinery as it requires considerable investment. Investment returns on large capacity addition or technology adoption shows up prominently in terms of savings and helps in benchmarking operations. Further, there is a strong feeling among the industry owners that, energy conservation-initiatives of replacement and retrofit nature is not a common practice as it involves large capital investment against low returns. In view of this and given the limited financial strength of

the coir industries, it is clear that the unit entrepreneurs would not take up the risk to invest in energy efficiency measures.

2.5.4 Manpower

Skilled workers are locally available to run the machines available in Alleppey. However, there is hardly any engineer employed in these enterprises and the production process remains traditional and also most of the units in the cluster are manually operated machines such as handlooms, dyeing and stenciling. Specialized training with local service providers for better operation and maintenance of equipments, importance of the energy and its use will create awareness among workforce. These programs should be organized along with equipment suppliers for a better impact.

CHAPTER 3
ENERGY AUDIT AND TECHNOLOGY ASSESSMENT STUDY

3.1 Methodology adopted for energy use & technology audit studies

A well planned methodology was adopted to execute the energy use and technology audit studies and to achieve the desired project objectives. Major steps which were followed during the energy use & technology studies of the project are mentioned below:

- Discussion with the industry representatives/local industry association
- Inventorization of the units so as to understand their energy consumption pattern
- Selection of suitable representative units to carry out end energy use and carry out technology assessment studies

The primary objective of energy audits is to quantify the existing fuel consumption pattern and to determine the operating efficiencies of existing systems. The key points targeted through energy audits were determination of specific fuel consumption, various losses, operation practices like hot metal temperature, existing air-fuel ratio, blower and burner parameters. Pre-planned methodology was followed to conduct the energy audits. The following sections describe details of methodology adopted in energy use and technology audits in Alleppey coir cluster.

3.1.1 Energy Use & Technology Audit Preliminary Studies

There are number of Associations in Alleppey coir cluster based on the type of the processing adopted like weaving, dyeing, stenciling, finishing, rubber works, and PVC tufted mats. The active associations working in the cluster are as follows.

S.No	Association Name
1	Alappuzha Coir Cluster Development Society
2	Mats & Matting Co-operative Society
3	Indian Coir Association
4	Kerala State Small Scale Industries Association

The Association provides a platform for development of mutual understanding among the like minded industries and has discussion relating to common problems and identification of viable solution and also acts as coordinator between the cluster units and various government agencies. Therefore, as a first step for initiating the studies in the cluster, the Association and its office bearers were approached. Detailed discussions

with the Association members were held to apprise the Association about the objective of the project, tentative schedule of the activities being undertaken and expected project outcome and how the program will benefit the SME unit owners in the cluster

The Associations members were apprised about benefits of the project for the industries and cluster. The Association took up the task to disseminate BEE – SME project related information among their respective member units. The outcome of this activity was introduction of project concept to the Association and later on to the industry. This helped in identifying progressive and interested entrepreneurs in the cluster.

3.1.2 Preliminary Energy Audit Studies

The methodology adopted to conduct preliminary energy audit study is presented below:

- Collection of past energy consumption details and energy bill
- List out major energy consuming areas of the plant
- Existing technology of various processes and utilities (latest or old, crude or efficient, local or reputed company make etc)
- Identification of the areas for special attention for low cost measures with quick payback period
- Understanding the detailed process with energy and material balance
- Establish specific energy consumption, if possible for the each typical equipment/process
- Identify the areas for detailed energy audit study and measurements required

3.1.3 Detailed energy audit studies

The methodology adopted to conduct detailed energy audit study is presented below:

- Collection of past energy consumption details and energy bill
- Listing of major energy consuming areas of the plant
- Identifying existing technology of various processes and utilities (latest or old, crude or efficient, local or reputed company make etc)
- Status of instruments installed in the plant and necessary instrumentation required for the detailed study
- Identification of the areas for special attention for low cost measures with quick payback period
- Understanding the detailed process with energy and material balance

- Monitoring & measuring of different parameters of various equipment / machines to evaluate performance
- Collection of operational data from various measuring instruments / gauges installed in the plant
- Compilation of design data/name plate details of various equipment from design manuals and brochures
- Discussions with concerned plant personnel to take note of operating practices and shop-floor practices being followed within the plant and to identify specific problem areas and bottlenecks if any with respect to energy consumption
- Critical analysis of data collected and parameters monitored
- Identification of energy wastage areas and quantification of energy losses
- Identification of suitable energy conservation measures for reducing energy consumption

3.1.4 Technological Audit

The methodology adopted to conduct technological audit is as follows:

- Identify major equipments and technologies of the plant
- Whether the equipments installed is local make or reputed company make
- Various energy sources available in the vicinity of the cluster
- Energy use and specific energy consumption details
- Identify major constraints for installing energy efficient equipments
- Whether energy efficient equipment suppliers are available locally and identify the suppliers
- The strategy followed for selection of equipment suppliers by the management
- Any research or survey carried out prior to selection of the technologies adopted and available
- Detailed interviews with the management for the interest in adopting new technologies for efficiency improvement
- Financial strength and investment that can be made for the improvement of energy efficiency by the plant management

3.2.1 Observations Made

A comprehensive study of the units carried out by WII has revealed the following:

- The status of some of the technologies installed like thermic fluid heaters, dyeing machines, compressors, pumps, power looms, PVC Tufting machines, hand looms, hot presses mixing mills etc are of lower grade as compared to the technologies and practices / equipments available in the market. Various technological gaps have been identified in the cluster units as under and these may be due to lack of awareness on the technologies available and non availability of LSPs or equipment suppliers.
- Though, the managements are interested in implementation, the energy loss areas and EE technologies could not be identified by the management or LSPs for implementation due to lack of awareness. Hence, the unit owners are depending entirely on the local technology suppliers for their low cost and their availability any point of time.
- The coir industries is an unorganized sector with limited technology innovation and poor R&D base as well as low level of human resource on knowledge of technology, and operational skill. The sector faces deficiencies such as the lack of access to technology, technology sharing, and inadequacies of strong organizational structure, and professional attitude.

3.2.2 Energy Consumption Profile

The major equipments installed in Alleppey coir cluster are as follows:

3.2.2.1 Handloom Weaving (no energy is consumed)

- Hand looms

3.2.2.2 Power loom Weaving

- Power looms
- Spooling machines
- Cops machines

3.2.2.3 Dyeing

- Dyeing vats
- Thermic fluid heaters
- Dryers
- Blowers
- Centrifuges
- Pumps

- Air Compressors
- Chulhas

3.2.2.4 Stenciling

- Air Compressors
- Shearing machines

3.2.2.5 Rubber works

- Mixing mill machines
- Hot Press machines
- Kneaders
- Thermic fluid heater or electric heaters

3.2.2.6 PVC Tufting

- PVC mixing machines
- PVC tufting machines
- Thermic fluid heater
- Blowers
- Air Compressor
- Motors
- Oil circulation pumps

3.2.2.7 Other sectors

- Infrared bulbs
- Stitching machines

3.2.3 Capacity Utilization

It noted that the capacity utilization of the plant is above 80% for all the units surveyed. The high capacity utilization is due to the high market demand for the products produced in the cluster. Most of the handlooms are operated on single shift basis and mechanized industries are working on two shift basis.

3.2.4 Housekeeping Practices

The coir industries in the cluster are maintaining poor operational practices in different utilities section of the units. There are no specific procedures followed in any of the units for the effective operation of various equipments/utilities in industries. Either the workers or the management doesn't have the knowledge on energy conservation and efficiency. There is no system to measure and monitor fuels or electricity consumed on daily basis in any of the units surveyed. Most of the process equipment installed is equipped with better control systems for maintaining the product quality. By improving the operational practices in various utilities in units, efficiency may improve by around 5% without any investment. Some of the suggested house-keeping practices are presented below:

- Automatic temperature controls for dyeing, drying and thermic fluid heaters.
- Maintaining proper air fuel ratio in thermic fluid heaters and boilers.
- Digital temperature indicators and automatic controllers in place of human monitoring further reduces the chances of overheating and hence energy and material loss in the conventional chulhas.
- Thermic fluid heater grates should be opened only when required for fuel feeding.
- Monitoring of compressed air pressure and reduction will reduce power consumption of air compressors.

3.2.5 Availability of Data and Information

The data and information pertaining to energy procurement and consumption is available in some of the cluster units. However, the equipment-wise consumption and production data is not available as it is kept confidential.

3.2.6 Any Other Relevant Aspect

Majority of the machine operators and helpers deployed in the cluster units are non technical and illiterates and their knowledge level is based on the past working experience. They do not have technical skills and knowledge on energy conservation. This is one of the important factor for inefficiency of the process and energy losses.

3.3 Technology Gap Analysis

The technology wise identified technological gaps and upgradations revealed during conduct of technology audit studies in Alleppey Coir cluster are mentioned below:

1. Thermic fluid heaters
2. Pumps
3. Conventional Chulhas

4. Air compressors
5. Blowers
6. Dryers
7. Handlooms
8. Spooling machines
9. Shearing machines
10. Electric Hot presses
11. Dyeing Watts

Technical gap analysis in above mentioned technological areas is presented in the following table:

Equipments	Technology Gaps Identified	Technology Interventions
Thermic fluid heaters	• Heat generation by use of diesel oil as fuel for thermic fluid heaters is costly	• Install wood gasifiers to reduce fuel and operation cost
Thermic fluid heaters and boilers	• High temperature flue gases is vented to the atmosphere without any heat recovery	• Install waste heat recovery system such as economizer or air pre-heater to increase efficiency.
Boiler feed water pumps	• Pumps are local make and are inefficient	• Install energy efficient vertical pumps (Grundfos or CRI make)
Chulhas	• Low efficiency • High radiation losses from all sides of wall • No proper air circulation • No waste heat recovery	• Install new improved design chulha developed by WII
Air compressors	• Low output than the rated capacity • Air is generated at higher pressure than required	• Install new screw compressors • Optimize air generation pressure
ID and FD fans	• No Speed control for ID and FD fans • The air flow is adjusted by mechanical dampers	• Install VFD's for ID and FD fans
Boilers	• No speed control for ID and FD fans • No speed control for thermic	• Install VFD's for ID and FD fans. • Optimization of Thermic

	fluid circulation pump	fluid pump speed by installing VFD
Handlooms	• High production cost due to low production and high manpower cost	• Install semi automatic Anupama and Anugraha looms
Coir	• Raw coir is purchased from outside, which is costly	• Install coir making machines and de-fibering machines in-house
Dyeing Watts	• High fuel and electricity consumption • In efficient pumps installed • More effluents generated creates environmental problems and increased effluent treatment cost • Hot water generated after completion of the process is drained to the ETP	• Energy efficient and reputed branded make pumps • Waste heat recovery system from hot effluents drained

3.4 Energy Conservation Measures Identified

3.4.1 Description of Proposals Including Technology / Product Specifications

The areas identified through conduct of technology audit studies in Alleppey coir cluster are mentioned below to reduce energy consumption in various types of units of the cluster and proposals for high, medium and low investment measures, no cost and other measures were like good housekeeping practice are presented in the section below.

Dyeing units

1. Wood gasifiers
2. Variable frequency drives
3. Chulhas
4. Solar hot water system
5. Waste heat recovery from hot drained water

Stenciling unit

1. Air compressors
2. Variable frequency drives

Weaving units

1. Anugraha power looms
2. Anupama power looms

Rubber units

1. Air compressors
2. Variable frequency drives
3. New energy efficient hot press

3.4.1.1 Wood Gasifiers

In Alleppey coir cluster, there are number of dyeing and PVC tufting units where hot air is generated through furnace oil fired thermic fluid heaters. The operational cost of furnace oil fired thermic fluid heater is higher due to high fuel cost. It is recommended to install wood gasifier for thermic fluid heater, where the producer gas (generated by wood gasifier) will be fired to generated heat for heating thermic fluid oil.

Benefits

- Low energy cost
- Low flue gas losses hence more efficiency
- Reduces GHG emissions
- Low operating costs
- Reliable, continuous delivery of cost effective energy and reduces dependence on fossil fuels

Barriers in implementation

- High initial investment
- Lack of awareness to use wood gasifier in the cluster units
- Lack of awareness on the financial benefits of wood gasifier

Cost benefits analysis

Cost benefits analysis to replace furnace oil fired thermic fluid heater with wood gasifier for a typical unit of PVC tufting unit is furnished in Table 12. The cost benefit analysis reveals by replacing furnace oil fired thermic fluid heater with wood based gasifier is quite lucrative with only 3 months pay back period.

Table 12: Cost Benefit Analysis for Wood Gasifier

Details	Units	Value
Capacity of thermic fluid heater	Kcal / hour	400,000
Nos. of operational hours per annum	Hours	4,400
Furnace oil consumption per day	Liters / day	1,000
Furnace oil consumption per annum	Liters / year	2,75,000
Furnace oil cost per annum	Rs. Lakhs / year	104.5
Wood Gasifier Details		
Wood consumption for same heat output	Kg / year	9,62,500
Wood cost per kg	Rs. / kg	3
Wood cost per year	Rs. Lakhs / year	28.88
Extra manpower required	Persons	6
Salary per month	Rs. / month / person	6,000
Annual manpower cost	Rs. Lakhs / year	4.32
Electricity Consumption	kW / hour	7.5
Electricity consumption per annum for wood preparation	kWh / annum	41,250
Electricity cost for wood gasifier per annum	Rs. Lakhs / year	2.06
Total energy and operation cost for gasifier per annum	Rs. Lakhs / year	35.26
Net monetary savings per annum	Rs. Lakhs / year	69.24
Investment required for wood gasifier	Rs. Lakhs	20.00
Payback period	Months	3

3.4.1.2 Variable Frequency Drives (VFD)

Based on the detailed energy audits conducted in various units, more than 90% of the units having thermic fluid heaters and it was found that blowers air flow is controlled by using mechanical dampers, whereas, flow control of pumps by throttling valves. The mechanical control device to control fluid flow is considered as in-efficient way to add up energy loss. If the fluid flow is controlled by reducing the fan motor speed, it would offer

an improved energy efficiency measures. In case of part load operation for a longer operation duration, the energy saving would be higher than expected. As the fan motor speed is reduced, the fluid flow will reduce partially, whereas, power consumption would reduce to the cube of the fan motor speed.

By reducing fan speed by 10% the fluid flow can be reduced by 10%, resulting to reduce power consumption by 25%. The motor speed may be controlled to desired speed by use of VFD controls, one of the most cost effective investments to enhance energy efficiency. The typical applications where energy savings can be confidently expected in Alleppey Coir Units, by using VFD are mentioned below.

- Induced draft fans and forced draft fans for thermic fluid heaters
- Oil circulation pumps
- Heat setting machine blowers
- Hydro extractors
- Pump motors of dyeing Watts

Benefits

- Reduction in breakdowns and smooth start
- Unity power factor
- Reduction in breakage and motor burnt
- Improved motor life, lesser breakdowns and production increase
- Reduction in production cost and maintenance cost due to frequent failures of belts, bearings, yarn breakages
- Improved power factor (0.98 across speed range)
- Maximize power distribution system
- Reduced inrush currents
- Minimize peak demand charges
- Soft start / soft stop
- Eliminates mechanical shock and stress on power train (couplings, belts, drive shafts, gear boxes, etc.)
- Reduce Operating costs of utility
- Reduced energy consumption, process operates at most efficient point
- Allows load shedding

- May qualify for utility rebates
- Controlled acceleration and deceleration
- Eliminates motor voltage imbalance
- Input power phase reversal protection

Barriers in implementation

Lack of awareness to use VFD's in ID and FD fans of various utilities (like blower)

Cost Benefit Analysis

The cost benefit analysis by installing VFD for a typical unit having thermic fluid heater in place of mechanical dampers to control flow of fluid (air) is furnished in Table 13. The cost benefit analysis reveled that simple pay back period works out to be only 7 months, which is preferred option.

Table 13: Cost Benefit Analysis of Variable Frequency Drives

Details	Value	Units
ID fan	kW	11.19
FD fan	kW	3.70
Dyeing Watts (3 nos.)	kW	16.50
Hot oil circulating pump	kW	11.19
Pump motor of dyeing (3 nos.)	kW	16.50
Hydro extractors (2 nos.)	kW	16.50
Blower motors of dryer (5 nos.)	kW	11.00
Total load	kW	86.58
% savings due to VFD installation	%	25.00
Power saving	kW	21.65
Nos. of operating hours per annum	Hours	5760
Power saving per annum	kWh	124,675.20
Power cost	Rs. / kWh	5.00
Monetary saving per annum	Rs. / year	623,376.00
Investment required to install VFDs	Rs.	368,283.00
Payback period	Months	7

3.4.1.3 Waste Heat Recovery System

Based on detailed energy audit studies undertaken, it has been observed that majority of the boilers or thermic fluid heaters doesn't have waste heat recovery system installed and the measure flue gases temperature is around 220 °C. The high temperature flue gas is vented out in the atmosphere without possible heat recovery. As wood is used as fuel sulphur contained is very low, the exhaust flue gas temperature can be reduced from 220 °C to 130 °C to extract considerable heat from flue gas. Hence, it is recommended to install waste heat recovery system for pre-heating the feed water and/or pre-heating combustion air by using heat available in waste flue gases.

Benefits

- Reduce fuel consumption
- Reduce GHG emissions
- Reduce process through put time to increase production
- Reduce production cost

Barriers for implementation

Lack of awareness

Cost benefit Analysis

The cost benefit analysis by installing waste heat recovery system to generate hot feed water is furnished below in Table 14. The cost benefit analysis revels that by installing waste heat recovery system the simple payback period comes to only 6 months, so the option to invest is beneficial.

Table 14: Cost Benefit Analysis of Installing Waste Heat Recovery

Details	Units	Value
Flue gas temperature	°C	220
Flue gas temperature after heat recovery	°C	130
Temperature difference	°C	90
% saving	%	4.50
Fuel saving per hour	Kg / hour	11.25
Operating hours per annum	Hours / annum	5,760
Fuel saving per annum	Kg / year	64,800
Fuel cost	Rs. / kg	3.00

Monetary savings per annum	Rs. / year	194,400
Investment required	Rs.	100,000
Payback period	Months	6

3.4.1.4 Hot Drained Water

The dyeing machines in cluster units are operated continuously. Hot water is used in the process of washing, scouring, bleaching, and dying. Hot water is circulated in the dyeing watts in the ratio ranging from 1:8 to 1:10 depending upon the fabric and finishing requirement. Hot water is generated in heat exchangers by use of steam vapour. To generate hot water for each machine individual/exclusive heat exchangers are installed. After completion of each process, hot water at 80 to 90 ^{o}C is drained out to the ETP. Each batch requires about 4 hot water wash, resulting huge quantity of hot water drained per day from all machines and considerable amount of heat is wasted.

Recommendation

Coir unit process requires considerable amount of hot water in other processes such as washing, dyeing and boiler feed water. A waste recovery system (waste heat recovery exchanger) may be used to recovery the heat from hot water which is drained and to use in other process or as boiler feed water.

Benefits

- Utilize heat available in hot drained water of soft flow machines and will reduce fuel consumption
- Enhance production capacity and reduce production cost
- Improve working environment due to temperature reduction of hot drained water
- Low investment and high returns
- No operation and maintenance costs

Barriers in Implementation

- Lack of awareness of technology
- High initial investment
- Space availability

Cost benefit Analysis

The cost benefit analysis by installing waste heat recovery system from hot drained water is furnished below in Table 15. The simple Payback period comes to around 43 months.

Table 15: Cost Benefit Analysis Heat Recovery from Hot Drained Water

Details	Value	Units
Nos. of dyeing machine	Nos.	2
Capacity of dyeing machine	Kg / batch	500
Nos. of dyeing batches per day	Nos.	7
% utilisation	%	70
Total quantity of dyeing per day	Kg / day	2,450
Material to liquid ratio	No unit	10
Nos. of times hot water wash	Nos.	1
Quantity of hot water drained	Liters / day	24,500
Hot water temperature	^{0}C	80
Ambient temperature	^{0}C	30
Hot water heat available	Kcal / day	1,225,000
% heat can be recovered	%	80
Quantity of heat can be recovered	Kcal / day	980,000
Waste heat recovery system efficiency	%	50
Calorific value of wood	Kcal / kg	3,800
Equivalent fuel saving	Kg / day	147
Nos. of operation days per annum	Day	288
Fuel saving per annum	Ton / year	42.46
Wood Cost	Rs. / ton	3,000
Monetary saving	Rs. / year	1.3
Investment required	Rs.	4.5
Payback period	Months	42.4

3.4.1.5 Solar Hot Water System

In Alleppey Coir Cluster units, dyeing and bleaching the process hot water requires temperature of 80 ℃. The solar isolation level and solar radiation at Alleppey is conducive to install solar based system. Average daily solar radiation on a collector surface tilted at an angle of 25° to the horizontal is 5.08 kWh/m² per day, equivalent to 1854 kWh/m² per year. The installation of solar based system will prove beneficial from all corners like environmental, aesthetic, and technical.

The capacity of the solar hot water system is worked out considering the following parameters:

- The area (also roof top) available within the plant
- Hot water requirement for dyeing and bleaching process or can be used as boiler feed water
- Availability of sunny days

The working of solar water heating system is based on the principles of black body absorption and heat transfer. The black surface of the collector absorbs the heat from the solar radiation and transfers it to the water passing through the copper tubes of the absorber panel. Hot water being lighter than cold water rises to the top of the collector and into the hot water tank. This cycle goes on during hours of sunshine (usually between 10 am to 4 pm). At the end of the day the tank is full of hot water at designed temperature. A typical solar water based system installed on roof top is provided in Figure 9.

Figure 9: Solar Water Heating system

Hot water at 80 ^{o}C can be generated for about 8 months in during a year. Hot water generated from solar hot water system may be used for dyeing process. Solar hot water systems are available with 100 to 10,000 LPD capacity and soft loans are available from the various financial institutions. The cost benefit analysis of installing Solar Water Heating System (SWHS) for a typical requirement of 1,000 LPD is furnished below Table 16.

Table 16: Cost Benefit Analysis for SWHS

Details	Units	Value
Capacity	Liters / day	1,000
Hot water temperature	^{o}C	80
Water inlet temperature to SWHS	^{o}C	30
Temperature difference	^{o}C	50
Heat required per day	Kcal / day	5,00,000
Efficiency of the present hot water generation	%	15
Nos. of days per annum	Day	150
Wood saving per annum	Kg / day	12,450
Wood cost	Rs. / kg	3.6
Monetary saving per annum	Rs. Lakhs	0.45
SWHS Cost (with subsidy)	Rs. Lakhs	1.61
Simple payback period	Year	3.3

Benefits of Solar Water Heating System (SWHS)

The benefits of the solar water heating system are as follows:

- Solar energy is a renewable energy source and is available abundantly.
- Solar water heating system doesn't require any fuel and hence reduces de-forestation due to reduction in wood consumption in the cluster and the biomass residues saved can be used for other productive purposes.
- SWHS system uses clean form of energy and doesn't emit toxic gases and protects environment.
- SWHS doesn't require manpower for operation and is maintenance free.
- Low margin money and interest rate, the amount saved due to reduction in fuel cost may be paid as loan installment.
- Subsidy from Central Government upto 20% of total cost.

3.4.1.6 Improved Chulha

There are about 10 designs of chulhas prevailing in the cluster with various sizes. The chulhas are used for generating hot water for dyeing process. The chulhas design are of conventional type and uses efficient open firing. Based on detailed studies carried out on chulhas, the efficiency was found to be very poor only about 10%. The low efficiency of the chulha is due to the following reasons:

- The traditional local make chulhas has no mechanism for air circulation and smoke removal.
- Heat losses through grate opening, from front and back end sides.
- No air control for combustion.
- Radiation losses from the all sides of the chulha.
- Lack of monitoring of wood (fuel) feeding.

Recommendation

WII has developed an improved chulha design. The improved Chula is 'Smokeless Chulha', of bigger size with a provision for regular air circulation, damper for regulating air flow for optimum combustion, optimized furnace area, improved grate design to reduce heat losses, maximum utilization heat from waste flue gases and chimney for smoke removal. These chulhas are easy to construct and requires minimal manpower training to construct. The efficiency of new chulha is around 25%.

The chulhas may be constructed in various sizes as per the plant requirement but the basic design remains same. The efficiency evaluation and cost benefit analysis of improved chulha is furnished below Table 17. The cost benefit analysis reveals that the payback period will be only 6 months.

Table 17: Efficiency Evaluation & Cost Benefit Analysis of Chulha

Details	Units	Value
Fuel used		Rubber Wood
Quantity of hot water generated	Liters / batch	1,200
Initial water temperature	°C	30
Final water temperature	°C	80
Heat output	Kcal / batch	60,000
Fire wood consumption	Kg / batch	150
Calorific value of fire wood	Kcal / kg	4,000
Heat input	Kcal / day	600,000
Efficiency of the chulha (present)	%	10
Efficiency of new designed chulha	%	25
Wood consumption per annum	Ton / annum	45

Fuel saving	%	50
Wood saving per annum	Ton / annum	27
Monetary saving	Rs. Lakhs / annum	0.78
Investment required	Rs. Lakhs	0.25
Payback period	Month	6

:

There are about 10 chulhas in the cluster and these chulhas can be replaced with new improved chulhas. The annual fuel savings is estimated is 270 tons of wood and monetary savings of Rs. 5.40 lakhs per annum. The total investment required for 10 units is Rs. 2.50 lakhs and simple payback period is 6 months.

Benefits of New Improved chulha

- Easy to construct, operate and repair. Maintenance required is minimal.
- Reduce process time by more than 50% and production is increased.
- Reduce man-hours for same production and the man-hours may be utilized for other purposes.
- Improved chulha efficiency will be around 25 to 30%, reduce in energy bill by more than 50% and profitability of the unit will be enhanced.
- Payback period is less than 6 months.
- Installing improved chulha would eventually less wood, as a result would decrease cutting down of trees, and provide help to save our environment.
- The workers health and working environment will improve.

3.4.1.7 Anupama looms

In Alleppey coir cluster, there are many handloom units which manufacture weave mats and mattings for coir or fiber. The weaving operation to produce mats is carried out by manually operated handlooms. The handloom requires two operates, one handloom operates, and other operator feeds in the raw coir into the handloom. After weaving operation, the coir mats are cut into the required size manually. The sized mats are taken for finishing and stenciling (designing) to other nearby units. The production cost for these types of handlooms are higher as more manpower (operator) is required.

The traditional handlooms have the following disadvantages:

- Less production per loom
- High production cost due to manually operated
- Frequent breakdowns/stoppages and hence more down time
- Less margins to the unit owner

Recommendation

In order to overcome the additional production cost, it is recommended to replace the handlooms by Anupam Semi Automatic Loom. Anupama Loom is a semi automatic loom developed by coir board in the year 2006. The loom is designed to produce all types of coir products such as coir mattings, mats, geo-textiles and carpets. The loom is designed to operate conveniently specially by women, as majority of the looms in the cluster are operated by women. The automatic loom produces almost double production than the existing handlooms for a single machine and hence reduces the production cost of fiber mats.

It is recommended to replace the present handlooms with Anupama Semi Automatic Looms for production of the fiber mats. The following are the advantages of the new looms:

- More production per machine and hence less production cost
- More quality and finishing
- Reduces dependence on manpower
- Wide variety of the mats and mattings can be produced on single machine

The Cost Benefit analysis of replacing the handlooms with Anupama Semi Automatic Looms is furnished for a typical unit in Table 18 below:

Table 18: Cost Benefit Analysis of Handlooms

Details	Unit	Value
Nos. of Handlooms (Manual)	Nos.	4
Daily production	Per day	60 feet of 3 feet width
Manpower cost	Rs. Per day/operator	180
Total manpower	Nos.	8

Manpower Cost	Rs. / day	1440
Nos. of semi automatic loom	Nos.	3
Daily production	Per day	60 feet of 3 feet width
Manpower cost	Rs. Per day/operator	180
Total manpower	Nos.	3
Manpower cost	Rs. / day	540
Savings in manpower cost	Rs. / day	900
Annual monetary savings	Rs. / day	2,70,000
Investment required for 3 Machines	Rs.	3,77,000
Simple Payback Period	Years	1.4

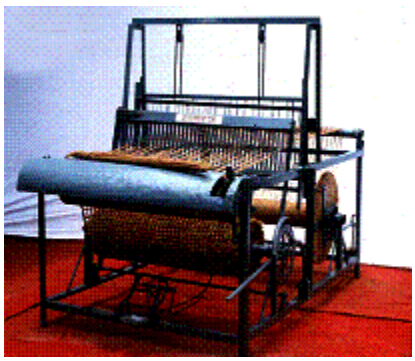
3.4.1.8 Anugraha looms

The production cost of fiber mats using manually operated handlooms is costly compared to semi automatic looms. It is recommended to replace the present handlooms with Anupama Semi Automatic Looms for production of fiber mats. The following are the advantages of the new looms:

- More production per machine and hence less production cost
- More quality and finishing
- Reduces dependence on manpower
- Wide variety of the mats and mattings can be produced in a single machine

Recommendation

There are five handlooms in the unit for weaving different sizes of mattings. The hand looms are operated as per the requirement. Two operators are required to operate single handloom machine, one to operate handloom and the other one for cops operation.



The cost benefit analysis shows that by replacing manually operated handlooms by semi automatic (Anugraha Looms) the simple payback period works out to be 0.6 years, the detailed cost benefit analysis for unit is shown in Table 19 below:

Table 19: Cost Benefit Analysis of Anugraha Looms

Details	Unit	Value
Nos. of Handlooms	Nos.	5
Daily production	Per day	150 Sq. Mts
Manpower cost	Rs. Per day / operator	250
Total manpower	Nos.	10
Manpower Cost	Rs. / day	2500
No of semi automatic loom	Nos.	4
Daily production	Per day	160 Sq. Mts
Man power cost	Rs. Per day / operator	250
Total man Power	Nos.	4
Total Man power cost	Rs. / day	1000
Savings in manpower cost	Rs. / day	1500
Annual monetary savings	Rs.	4,50,000
Investment required for 4 Machines	Rs.	3,00,000
Payback period	Years	0.6

3.4.1.9 Screw Compressors

In Alleppey coir cluster, use of compressed air is in stenciling units. After processing of coir mats in shearing machine for smooth surface finish, the design pattern is placed on the coir mat and colors are sprayed on the pattern, the design is embossed on the surface of the coir mat. The compressed air is used for spraying. After completion of the stenciling process, the coir mats are dried under natural sunlight and is finally finished manually for removing unwanted materials on the coir mat and is delivered to the customers.

It was found that in most of the units in the cluster, the actual efficiency of the compressor is less and the Specific Power Consumption (SPC) was on higher side. This could be mainly due to wear and tear in the moving parts of compressors, such as piston cylinder assembly, filter chocking and age of compressors. By overhauling these compressors, the capacity of the compressor can be increased, which will lead to

reduction of SPC. The operating pressure is maintained at higher than the required pressure, leads to high power consumption.

Recommendation

It is recommended to overhaul the compressor immediately to enhance the performance and if required replace worn out parts. The investment required towards overhauling is marginal and hence the payback period is immediate. The cost benefit analysis of the recommended measure is furnished below in Table 20.

It is also recommended to take the compressor for maintenance for every 6 months or as recommended by the equipment supplier for better performance of the air compressor.

Table 20: Energy Saving Potential by Overhauling Compressor

Details	Units	Value
Specific power consumption	kW / m^3 / hr	0.214
Volumetric efficiency	%	56.1
Expected volumetric efficiency	%	90
Optimum specific power consumption	kW / m^3 / hr	0.133
Power saving	kWh / hr	1.93
No. of operation hours	Hrs / year	1,600
Power consumption	kWh / year	3,086
Annual savings	Rs. / year	15,434

The reduction in operating pressure for design pressure at utilization end will reduce the operation and maintenance cost of the plant as at high pressure operation compressors lead to more bear and tear losses. It is recommended to reduce compressor air pressure to required air pressure. By doing so, the power consumption reduces. The saving calculation is given below in Table 21.

Table 21: Energy Saving Potential by Reducing Pressure

Details	Units	Value
Present operating pressure	Kg / cm^2	7
Proposed operating pressure	Kg / cm^2	5
Present power input	kW	5.1
Daily operation hours	Hours	4
Expected saving	%	10
Power saving	kW	0.51
Annual operation days	Days	200

Energy saving potential	kWh / year	410
Energy charges	Rs. / kWh	5
Annual saving	Rs. / year	2050
Simple payback period	Year	Immediate

No investment is envisaged for implementing the measure, resulting to immediate payback period.

3.4.1.10Energy Efficient Hot Press

In Alleppey coir cluster, the hot press is used for pressing the rubberized coir mattresses to enhance bonding with coir. About 130 to 140 ^{o}C temperature is maintained in the hot press. The hot press is kept at open, insulation and doors is not there and pressing operation is carried out at open condition leading heat dissipation from all sides of the hot press increasing heaters electricity consumption.

Recommendation

It is recommended to install insulated doors for hot press to arrest heat to dissipate outside. It is estimated that around 15~20% of electricity consumption will be reduced as furnished in Table 22.

Table 22: Energy Saving Potential for Hot Press

Details	Units	Value
Nos. of hot pressed	Nos.	1
Annual energy consumption	kWh / year	6,000
Saving	%	20
Estimated annual saving	kWh	1,200
Cost of electricity	Rs. / kWh	5
Monetary savings	Rs. / year	6,000
Investment required	Rs.	3,000
Payback period	Month	6

3.4.2 Life Cycle Analysis for the Suggested Energy Saving Proposals

The life cycle analysis for each of the suggested energy saving proposal has been prepared as per the Indian industry norms, government policies, and as per the guarantee provided by the equipment/technology suppliers and presented below in Table 23.

Table 23: Life Cycle Analysis for Energy Saving Proposals Suggested

S.No	Energy Saving Proposal	Life Cycle Analysis
1	**Wood gasifier**	Wood gasifier life is considered as 15 years. Depreciation is considered at 80% by straight line method.
2	**Variable frequency drive**	Variable frequency drive life is considered as 15 years. Depreciation is considered at 80% by straight line method.
3	**Waste heat recovery for boiler and thermic fluid heater for flue gas**	Waste heat recovery system life is considered as 15 years. Depreciation is considered at 80% by straight line method.
4	**Heat recovery from hot drained water**	Heat recovery system life is considered as 15 years. Depreciation is considered at 80% by straight line method.
5	**Solar hot water system**	Solar hot water system life is considered as 15 years. Depreciation is considered at 80% by straight line method.
6	**Improved chulha**	Improved chulha life is considered as 5 years. Depreciation is considered as 5.28% by straight line method.
7	**Anupama loom**	Anupama loom life is considered as 20 years. Depreciation is considered at 5.28% by straight line method.
8	**Anugraha loom**	Anugraha loom life is considered as 20 years. Depreciation is considered at 5.28% by straight line method.
9	**Screw compressor**	Screw compressor life is considered as 20 years. Depreciation is considered at 5.28% by straight line method.
10	**Hot press (energy efficient)**	Hot press life is considered as 20 years. Depreciation is considered at 5.28% by straight line method.

3.4.3 Cost of Implementation

The investment required for various proposals identified at Alleppey Coir Cluster is furnished in Table 24 and unit wise investment required for various proposals suggested is furnished in Annexure 6.

Table 24: Details of Cost of Implementation

Equipment Details	Plant and machinery (Lakh)	Civil works (Lakh)	Electrical works (Lakh)	Erection & commiss-ioning (Lakh)	Miscell-aneous (Lakh)	Total cost (Lakh)
Wood Gasifier						
0.46 MW	22.00	0.20	-	-	0.56	22.76
Variable frequency drives						
3 HP	0.15	-	-	0.05	0.01	0.21
5 HP	0.21	-	-	0.05	0.01	0.27
7.5 HP	0.30	-	-	0.05	0.01	0.36
Waste heat recovery from boiler flue gas						
3.0 TPH	2.0	-	-	0.05	0.05	2.10
Heat recovery from hot drained water						
2 kL	4.50	-	-	0.30	0.12	4.92
4 kL	6.00	-	-	0.40	0.16	6.56
Solar hot water system						
1000 LPD	1.55	-	-	0.02	0.04	1.61
Improved Chulha						
1200 LPD	0.25	0.25	-	-	0.01	0.51
Anupama Loom						
15 to 18 mats/day	4.5	-	-	0.05	0.11	4.66
Anugraha Loom						
Matting's loom	1.0	-	-	0.05	0.03	1.08
Screw compressor						
Reduce operating pressure	-	-	-	-	-	-
Hot press						
Insulation for Hot Press	0.03	-	-	-	-	0.03

3.4.4 Monetary Savings & Simple Payback Period

As per the detailed audits carried out on various equipments of Alleppey coir units, the monetary savings and simple payback period have been estimated for each proposal and the details are furnished in Table 25 below.

Table 25: Energy Saving Details for Suggested Energy Saving Proposals

Equipment Details	Electricity saving (kWh/year)	Fuel saving (Ton/year)	Monetary saving (Rs. lakhs)	Investment (Rs. lakhs)	Simple payback period (Month)
Wood gasifier	-	-	69.24	20	3
Variable frequency drive	1,24,675	-	6.23	3.68	8
Waste heat recovery from boiler flue gas	-	64	1.94	1	6
Heat recovery from hot drained water	-	42	1.3	4.5	42
Solar hot water system	-	21	0.45	1.61	40
Improved chulhas	-	27	0.54	0.25	5
Anugraha loom	-	-	4.5	3	7.2
Anupama loom	-	-	2.77	3.77	16.8
Screw compressor	3,201	-	0.16	-	Immediate
Hot press	1,432	-	0.07	0.03	5

3.4.5 Issues/Barriers in Implementation EE Proposals

The major barriers identified for implementation of the proposals in the cluster units are described below:

- One of the major barriers is lack of awareness and lack of information source among the cluster owners on energy and monetary losses, EE technologies, and energy efficiency. A few demonstration projects may motivate the cluster to take up such projects themselves.
- About 80% of cluster unit owners don't have financial strength to implement high cost technologies like wood gasifier, energy efficient boilers, heat recovery systems, power looms, hot presses, chulhas and etc. However, the owners are interested to implement low cost measures having quick payback period less than 2 years.
- LSPs don't have technical strengths to supply efficient equipments.
- Production loss incurred during implementation of energy saving proposals.

3.4.6 Availability of Technologies in Local / National / International Market

For majority of the technologies and proposals identified, the equipments suppliers / dealers / branch offices are available locally in Cochin and Alleppey. The high investment technologies like Anupama looms and wood gasifier need to be procured from other places like Cochin and Chennai. Among the technologies / equipments identified for implementation for Alleppey Coir cluster units, some of the measures can be implemented by the local service providers and the rest equipments can be procured

at nearest city i.e., Cochin. The details of equipment which can be implemented by LSPs and those needs to be procured from other cities are furnished below in Table 26. The details of LSPs for each proposal are furnished in **Annexure 2**.

Table 26: Details of Technologies Available for Suggested Proposals

Equipment details	Alleppey, Polachi & Cochin	Chennai	International
Wood gasifier		√	√
Variable frequency drive	√	√	√
Heat recovery from hot drained water	√	√	
Heat recovery from boiler flue gas	√	√	
Energy efficient boilers		√	√
Improved chulha	√	√	
Anupama loom	√	√	
Anugraha loom	√	√	
Lighting	√	√	
Screw compressor	√	√	√
Hot press	√	√	
De-fibering machine	√	√	

√ *Available*

3.5 Identification of Technologies / Equipments for DPR Preparation

The cluster units are engaged in production of coir mats, matting, coir tufting, coir mattresses etc. The manufacturing process and equipments installed are identical for most of the cluster units.

Based on the detailed studies carried out, there is considerable potential in all cluster units for energy conservation and efficiency and also reduction of production cost by installing new and latest machinery.

As the process and equipments are more or less similar in all cluster units, all the technologies / equipments identified can be replicated as per the requirement and detailed project reports for the specific technologies prepared also can be replicated for different units as per the capacity requirement.

The technologies / equipments considered for preparation of detailed project report are furnished in Table 27.

Table 27: List of Technologies Considered for DPR Preparation

Technology/equipment	Nos. of DPRs	Capacities
Wood gasifier	2	• 4 lakh Kcal/hr • 6 lakh Kcal/hr
Variable frequency drive	2	• 4 nos • 6 nos
Solar water heating system	2	• 500 LPD • 1000 LPD
Economizer	2	• Boiler • Thermic fluid heaters
Hot drained water	1	• 2 kL/hr
Energy efficient chulha	1	• 1200 LPD
Anupama Loom	2	• 2 machine • 4 machine
Anugraha loom	2	• 2 machine • 4 machine
Hot press	1	
Total DRPs	15	

3.6 Environmental Benefits

3.6.1 Reduction in Waste Generation

By implementing various energy saving proposals identified, there will be significant reduction in waste generation and effluents such as in dyeing watts.

3.6.2 Reduction in GHG Emission

The major GHG emission reduction source is CO_2 due to implementation of the technologies identified, as the identified technologies will reduce grid electricity consumption and fossil fuel like coal. The total emission reductions is estimated as 4,800 tons of CO_2 per annum (total grid electricity can be saved is 5.21 GWh / year and emission factor is 920 tCO_2 / GWh) due to reduction in grid electricity consumption and 7,037 tons of CO_2 due to reduction in furnace oil and non-renewable wood consumption. The total estimated CO_2 emission reduction per annum is 11,837 tons of CO_2 in the entire cluster units.

3.6.3 Reduction in Other Emission

The technologies identified upon implementation for the Alleppey Coir cluster units will reduce grid electricity, wood and other fossil fuels consumption. The reduction in grid electricity consumption will reduce sulphur dioxide and SPM emission to the atmosphere at power plants.

CHAPTER 4
CONCLUSION

4.1 Summary of Energy Saving Measures Identified for the Cluster

The summary of the energy saving proposals identified for Alleppey Coir units is furnished below in Table 28.

Table 28: Summary of Energy Saving Proposals Identified

S. No	Energy Saving Proposals
1	Wood gasifier
2	Variable frequency drive
3	Heat recovery from boiler flue gas
4	Heat recovery from hot drained water
5	Solar water heat system
6	Improved chulhas
7	Screw compressor
8	Anugraha loom
9	Anupama loom
10	Hot press
11	De-fibering machine

4.2 Selected Technologies / Products for DPRs

The following technologies / products were selected for preparation of detailed project reports for Alleppey Coir Cluster.

- Wood gasifier
- Variable frequency drives
- Solar water heating system
- Heat recovery from hot drained water
- Waste heat recovery system
- Economizer
- Hot press
- Anupama loom
- Anugraha loom
- Chulhas

4.3 Summary of Level of Awareness on Energy Saving and Energy Saving Technologies

The level of awareness on energy saving among the SME owners in the cluster is poor. About 10% of the unit owners have good conscious on energy saving technologies and is limited to waste heat recovery systems and doesn't have knowledge on other energy saving technologies like VFD's, waste heat recovery, energy efficient chulhas and etc. The lack of awareness may be due to lack of skilled and technical manpower among other factors and most of the units in the cluster are tiny and micro enterprises.

The energy saving technologies are implemented based on success stories in the cluster units and practical demonstration of the energy saving technologies in the units. Some of the low cost demonstration projects in the cluster may motivate the SME owners in implementation of the energy saving technologies.

4.4 Summary

In this section summary of outcome of energy use and technology audit conducted in Alleppey Coir cluster is discussed, which include identified energy conservation measures, energy & monetary benefits, payback period, issues in implementation. Details of the same are furnished in Table 29 below.

S. No	Energy conservation measure	Annual Energy / Fuel saving	Annual Monetary saving (Rs. Lakhs)	Implemen-tation cost (Rs. Lakhs)	Simple payback period (Years)	Issues in implementation	Short listed for DPR preparation (Yes/No)	Nos. of units can implement	Annual energy saving potential in cluster
1	Wood gasifier	-	69.24	20	3	▪ Lack of technology awareness ▪ High initial cost	Yes	6	164.80 KL
2	Variable frequency drives	1,24,675 kWh	6.23	3.68	8	▪ Lack of EC measure awareness	Yes	40	49,87,000 kWh
3	Waste heat recovery from boiler flue gas	64 tones	1.94	1	6	▪ Lack of EC measure awareness ▪ Non availability of LSP	Yes	5	320 tones
4	Heat recovery from hot drained water	42 tones	1.3	4.5	42	▪ Lack of awareness EC measure ▪ Non availability of LSP	Yes	15	630 tones
5	Solar hot water system	12.4 tones	0.45	1.61	39	▪ Lack of EC measure awareness ▪ Non availability of LSP ▪ High initial cost	Yes	50	625 tones
6	Improved chulhas	27 tones	0.54	0.25	5	▪ Lack of awareness EC measure ▪ Non availability of LSP	Yes	60	1,620 tones
7	Air compressor	3,201 kWh	0.16	-	Immediate	▪ Lack of EC measure awareness	No	90	2,88,090 kWh
8	Anupama Loom	-	-	-	-	▪ Lack of technology awareness ▪ High initial cost	Yes	-	-

S. No	Energy conservation measure	Annual Energy / Fuel saving	Annual Monetary saving (Rs. Lakhs)	Implemen-tation cost (Rs. Lakhs)	Simple payback period (Years)	Issues in implementation	Short listed for DPR preparation (Yes/No)	Nos. of units can implement	Annual energy saving potential in cluster
9	Anugraha loom	-	-	-	-	▪ Lack of technology awareness ▪ High initial cost	Yes	-	-
10	Hot press	1,432 kWh	0.07	3,000	0.5	▪ Lack of technology awareness	Yes	25	35,800 kWh
11	De-fibering machine	-	-	-	-	▪ High initial investment ▪ Climate condition	No	-	-

ANNEXURE 1

Detailed technology/equipment assessment report including the design technical specifications, in the format provided by BEE.

The technology gap assessment had been carried for each of the energy saving proposal recommended and is furnished below in Table 30.

Table 30: Technology gap assessment for the suggested energy saving proposals

Equipments	Technology Gaps Identified	Technology Interventions
Dyeing Watt	• High fuel and electricity consumption • Inefficient pump • More effluent generated and more treatment cost and environmental problem • Hot water generated after completion of the process is drained to ETP	• Energy efficient and reputed branded make pump • Waste heat recovery from hot drained effluent Energy efficient and reputed
Thermic fluid heater	• Heat generation by use of diesel oil as fuel for thermic fluid heaters is costly	• Install wood gasifier for fuel consumption and operation cost reduction
ID and FD fan	• No Speed control for ID and FD fan • The air flow is adjusted by mechanical damper	• Install VFD's for ID and FD fan
Boiler	• No speed control for ID and FD fan • No speed control for thermic fluid circulation pump	• Install VFD's for ID and FD fan • Optimization of thermic fluid pump speed by installing VFD
Boiler feed water pump	• Pump is local make and are inefficient	• Install energy efficient vertical pump (Grundfos or CRI make)
Air compressor	• Low output than the rated capacity • Compressed air is generated at higher pressure than required	• Install new screw compressor • Optimize air generation pressure

Chulhas	• Low efficiency • High radiation losses from all the sides • No proper air circulation • No waste heat recovery	• Install new improved design chulha developed by Winrock
Thermic fluid heater and boiler	• High temperature flue gas is vented to atmosphere without heat recovery	• Install waste heat recovery system such as economizer or air pre-heater
Handloom	• High production cost due to low production and high manpower cost	• Install semi automatic Anupama and Anugraha loom
Coir	• Raw coir is purchased from outside, which is costly	• Install coir making machine and de-fibering machine

ANNEXURE – 2

Details of Technologies / Services Providers for the Cluster

Company Name	Contact Person	Phone Nos.	Address
City Electricals (Air Compressor)	-	0491 - 2501525	10/1059, Saphare Square Building, Opp. Malayala Manorama, T.B. Road, Palakkad, Kerala
Confident Automation In Coimbatore (AC Drives)	-	0422-3218099	23, Venkatalakshmi Nagar, Trichy Road, Singanallur, Coimbatore-5
SMEC Automatic Pvt. Ltd. (AC Drives)	-	0484 - 2363596	57 / 545, Karikkamuri Cross Road, Cochin, Ernakulam, Cochin
Lakshmi Marketing (Pumps)	Mr. Kathiresan	9894026899	32, Eswaramoorthi Layout, Laruvam Palayam, 1st Street, Tirupur Bazaar, Tirupur - 641604
MOS SYSTEMS & CONTROLS (solar)	Mr. Sureshkumar	0484 2534 087, 98461 44221	Bank Road, Kaloor Cochin - 17, Kerala
Spac Power Engineering India Private Limited (Biomass gasifiers)	Mr. Praveen Miranda	044-26261660 9444409982 044-26261661	No. 73-A Block, 5th Street, Anna Nagar East, Chennai, Tamil Nadu - 600 040
Sri Jagathees Product (Biomass gasifiers)	Mr. R. Rajendran	0421 232628/ 222628/ 9443132628	No. 275-A, Sankarankoil Road, Rajapalaiyam, Tamil Nadu - 626 117
Kardi Dryers Private Limited	-	9944919574	284, Avvai Shanmugam Salai, Chennai, Tamil Nadu - 600086, India
Cones India Engineering Works (Coir machinery)	-	04259-228811	183/2C-2, Thuran Fibre Compound, Rangasamudhram, Suleeswaranpatti, Pollachi - 642006
Dollar Industrial Machines (Coir machinery)	Mr. Raja Gopal	04373-222308/ 235408(R)	R.S. 109/3, Palamuthi Road, Thanjavur District, Pattukkottai - Tamil Nadu - 614604
MAS Engineering Works (Anugraha)	-	0472-2585331, 9447770331.	Vattinadu Branch, Vattappara. P.O, Thiruvananthapuram - 695028
Sagar Nylon Products (India) Pvt. Ltd.	-	0472-2728241, 2704546	TC-XV/76, CSM Road, Vellayambalam,Sasthamangalam, Thiruvananthapuram - 695010
Rhydo Technologies (Private) Limited	-	0484-2370575/ 3258390	Golden Plaza, Opp.Mymoon Theatre, Chittoor Road, Kochi, Kerala–682018
Powermech Cochin (Air Compressor)	-	95-484 - 2357555	Cears Towers, Alappat Cross Road, Cochin
Chicago Pneumatic Sales (Air Compressor)	-	95 - 484 - 2365559, 2355174	48 / 6184, Divya Gopala Prabhu Road, Cochin - 682035
Geekay Pneumatics Pvt. Ltd. (Air Compressor)	-	91 - 484 - 2364024, 0484 - 2371364	41 / 1764, Town Hall Road, Ernakulam North, Cochin - 682 018

(Enclosed)

ANNEXURE – 3

Quotations or Techno – Commercial Bids from Service / Technology Providers

TANGENT TECHNOLOGIES

M/s Winrock International India
Hyderabad

Dealt by
Anurag Gupta
Direct Tel.No.: 0265-2291264
Fax: 0265 2291568 Mobile:
9825500449 Email:
anurag.gupta@tangent.in Website:
www.tangent.in

Date **Our reference -**
20/02/11 15090492 - WII

Dear Sir,

We thank you for the above-referred enquiry for Variable Frequency Drive. We take this opportunity to offer our range of product - **Emotron/Tangent make of Variable Frequency Drive**

We hope this is in line with your requirement. In case, you have any queries or require additional information relating to this proposal, please feel free contact us.

Thanking you and assuring you our best attention, we remain

Yours truly,
TANGENT TECHNOLOGIES

Anurag Gupta
Director
105, Ambica Complex Nr. Alembic Nagar Gorwa Refinary Road Vadodara - 390016 Tel: 0265-2291568 Fax: 0265-2291264 Mobile – 09825500449

TANGENT TECHNOLOGIES

Scope Of Supply and Price Schedule

Sl.	Description	Qty	Unit Price (Ex Works Vadodara)
1.	Emotron/Tangent make Variable Frequency Drive of VSCplus series suitable for 1 NO. 415V, 50Hz 3 phase **2.2KW/ 3HP AC Motor** **Power Rating: 2.2kw / 3HP** • Protection Class of VFD: IP20 • Sensorless Vector Control • Overload duty: 150% for 2 minutes • 50degC Ambient	01	**Rs. 15,600/-**
2.	Emotron/Tangent make Variable Frequency Drive of VSCplus series suitable for 1 NO. 415V, 50Hz 3 phase **3.7KW/ 5HP AC Motor Power Rating: 0.75kw / 1HP** • Protection Class of VFD: IP20 • Sensorless Vector Control • Overload duty: 150% for 2 minutes 50degC Ambient	01	**Rs. 18,600/-**
3.	Emotron/Tangent make Variable Frequency Drive of VSCplus series suitable for 1 NO. 415V, 50Hz 3 phase **5.5KW/ 7.5HP AC Motor** **Power Rating: 5.5kw / 7.5HP** • Protection Class of VFD: IP20 • Sensorless Vector Control • Overload duty: 150% for 2 minutes • 50degC Ambient	01	**Rs. 23,700/-**
4.	Emotron/Tangent make Variable Frequency Drive of VSCplus series suitable for 1 NO. 415V, 50Hz 3 phase **7.5KW/ 10HP AC Motor** **Power Rating: 7.5kw / 10HP** • Protection Class of VFD: IP20 • Sensorless Vector Control • Overload duty: 150% for 2 minutes • 50degC Ambient	01	**Rs. 27,500/-**

Exclusions :

- Mounting frames if any for motor and VFD.
- Power, control, screened cables and all cable accessories.
- Erection of the equipment.
- Motors and Tachogenerators.
- Alignment of the motor with the load.

SAGAR NYLON PRODUCTS (INDIA) PRIVATE LIMITED

Factory at: Plot No-12A, Kinfra Apparel Park, Thumba, St. Xavier's College P.O., Thiruvananthapuram-695586, Kerala. Phone: 0471-2704546

Date.....

To

M/s. Windrock International India
Attn: Mr. Rakesh

Sub:- Quotation for Coir Products

Sir,

We are pleased to quote for the following

1.	Traditional Motorised Coir Ratt	-	Rs. 5500 per Ratt.
2.	Anugraha loom - 1m width	-	Rs. 30,000 per loom
3.	Anupam loom - 1m width	-	Rs. 5.5 lakhs per loom
4.	Mobile Defibering Unit	-	Rs. 1.5 lakhs per unit

Terms and conditions

50% Advance as payment and balance on delivery.
Supply within 30 days after receiving purchase order.

Kindly furnish orders in favour of us.

Thanking you,

Yours sincerely

Managing Director

TATA BP SOLAR INDIA LTD.,

103,Gera Sterling, North Main Road, Koregaon Park, Pune - 411 001 Tel. No. 91 20 26138262, 26122344, Fax: 91 20 66012741 Website: www.tatabpsolar.com

Date:- 18th March 2010

Ref: TBP/CUST/0910/UVD-1803

To,
Winrock International India
E-24, Vikrampuri
Secunderabad - 500009
Andhra Pradesh
Tel: +91-40-27845276 / 27843787
Fax: + 91- 040-27840988

Tel: +91 40 23376630 /23376631

Dear Sir,

Subject: **Offer for Solar Water Heating System for 1no x 1000 LPD Std@60 deg. C Vajra Model.**

As per your email dated 18th March regarding your requirement of Solar Water Heating System, we are pleased to submit our proposal for Solar Water Heating System from our range of TBP solar products.

1) SWHS for Solar Flat Plate Collectors 1000 LPD domestic type VAJRA puf insulated Horizontal model for water heating systems of your industrial requirement. For bigger capacity you need to multiple of 1000 Ltrs systems.

Scope of Supply, Exclusions, Price Schedule, Terms & Conditions of some installed systems are attached.

Please feel free to contact us for any clarifications regarding our offer. Thanking & assuring you of our services at all times. Your's Faithfully,

For **TATA BP SOLAR INDIA LTD.,**

Ujwal V Dusane
Sr. Engineer (Sales & Mktg) - Thermal Cell # 9096758187

TATA BP SOLAR INDIA LTD.,
103,Gera Sterling, North Main Road, Koregaon Park, Pune - 411 001
Tel. No. 91 20 26138262, 26122344, Fax: 91 20 66012741
Website: www.tatabpsolar.com

A. Technical Specifications

FLAT PLATE COLLECTORS COLLECTOR SPECIFICATION (I.S.I Mark)

1. Collector Frame	Specially Designed Extruded Aluminium
2. Collector Type	**Cu-Cu** Fin and tube type **Laser Welded Fins.**
3. Absorber Coating	Selective - **NALSUN Coating.**
4. Absorber Plate	Copper
5. Raiser	Cu Dia 12.9mm
6. Inlet Header	Copper -Dia 25.4mm
7. Bottom Insulation	Rock wool, below raiser assembly.
8. Side Insulation	Rock Wool
9. Reflective Foil	Aluminium Sheet .
10. Coating Absorptivity	> 0.95.
11. Coating Emmissivity	< 0.20
12. Transmitivity	85%
13. Glazing (Cover)	**Toughened Clear Glass.**
14. Gasket for Glass (Beeding)	EPDM U Type Gasket
15. Collector Back Sheet	Aluminium.
16. Hardware	Stainless Steel - 304
17. Finish Spray Painting	Golden Yellow
18. Insulation	Rock wool.
19. Grommet angles	EPDM for Frame and Mack Black for Glass retaining
20. Sealing	Silicon sealant between Glass, Clamp and Casing.
21. Header Inlet & Outlet	Brass Flanges
22. Weight	38 Kg (Dry), 46 Kg (Flooded)
23. Collector Support Structure	35 x 35 x 3 mm, M. S. angle, black painted.
24. Operating Conditions	10 °C. To 50 °C.
25. Window Velocity	75 Km/Hr*
26. Termination	65 mm Dia. Brass Flanges with 4 holes of Dia. 7mm at PCD 45mm, EPDM Gasket & 4 nos. of M6 x 20, SS 304 Bolts.

Features :-

- Corrosion resistance, Extruded Aluminium sections with Stainless Steel fasteners.
- High Transmissivity, Toughened and Tempered Glass.
- Designed, Manufactured and Certified as per " BIS" standard specifications.
- Design Registered with Patent Office (Patent Reg. No. 175095).

TATA BP SOLAR INDIA LTD.,
103,Gera Sterling, North Main Road, Koregaon Park, Pune - 411 001
Tel. No. 91 20 26138262, 26122344, Fax: 91 20 66012741
Website: www.tatabpsolar.com

INSULATED HOT WATER TANK

1.	Tank Type	: Cylindrical - Horizontal
2.	Capacity	: 1000 Liters
3.	Material	: Stainless Steel, 304 Grade.
4.	Insulation	: PUF.
5.	Cladding Material	: Aluminium.
6.	Sacrificial Anode	: To take care of Galvanic Corrosion
7.	Tank Stand	: M.S. Stand, Black Painted.

All the above specifications are standard specifications. The specifications will vary depending on the scope of supply. The makes may change from time to time depending on market conditions, but will be meeting our own quality standards.

APPENDIX – 1

Policy / Guidelines (if any) of Local Bodies for Improving Energy Efficiency in the Cluster

Note: There is no policy or guidelines available with local bodies for improving energy efficiency in the cluster

APPENDIX – 2

Financial Schemes (if any) Available with Local Banks for Improving Energy Efficiency in the Cluster

1. Credit Linked Capital Subsidy Scheme(CLCSS)

Under this scheme, the ministry of MSME is providing subsidy to upgrade technology (Machinery/plant equipments). Subsidy limit per unit is Rs. 15 lakh or 15% of investment in eligible machinery/Plant equipments whichever is lower. For more details of the scheme visit: www.laghu-udyog.com/scheme/sccredit.htm

2. SIDBI Financing Scheme for Energy Saving Projects in MSME sector under JICA Line of Credit

The Japan International Corporation Agency (JICA) has extended a line of credit to SIDBI for financing Energy Saving projects in Micro, Small and Medium Enterprises (MSMEs). This project is expected to encourage MSME units to undertake energy saving investment in plant and machinery to reduce energy consumption, enhance energy efficiency, reduce CO_2 emissions, and improve the profitability of units in the long run.

Eligible Sub Projects/ Energy Saving Equipment List under JICA line of Credit:

- Acquisition (including lease and rental) of energy saving equipments, including newly installing, remodeling and upgrading of those existing
- Replacement of obsolete equipments and/or introduction of additional equipment which would improve performance
- Equipments/ Machinery that meets energy performance standards/Acts
- Introduction of equipments that utilize alternative energy sources such as natural gas, renewable energy etc., instead of fossil fuels such as Oil and Coal etc.
- Clean Development Mechanism (CDM) projects at cluster level that involves change in process and technologies as a whole, duly supported by technical consultancy will be eligible for coverage.

Financial parameters:
The financial parameters for appraising the project are:

Parameter	Norms
Minimum Assistance	Rs. 10 lakh
Minimum promoters contribution	25% for existing units; 33% for new units
Interest rate	The project expenditure eligible for coverage under the line will carry a rate of interest rate of 9.5 - 10% p.a
Upfront fee	Nonrefundable upfront fee of 1% of sanctioned loan plus applicable service tax

Repayment period	Need based. Normally the repayment period does not extend beyond 7 years. However, a longer repayment period of more than 7 years can be considered under the line if necessary

Eligibility criteria for units (Direct assistance):

- Existing units should have satisfactory track record of past performance and sound financial position.
- Projects will be screened as per Energy Saving List, which is available in SIDBI website.
- Units should have minimum investment grade rating of SIDBI.
- Projects which may result environmental impacts and negative social impacts are also not eligible under this scheme.

For further details eligible energy saving equipments/machinery, projects can be financed under this scheme and details of scheme, please contact the nearest SIDBI branch office or refer to SIDBI website (**www.sidbi.in**)

3. Technology Upgradation Fund Scheme (TUFS) for Coir & Jute Industries in SSI Sector

A scheme devised by Govt. of India, Ministry of Coir, to enable SSI units Coir/Jute industrial sector to induct State-of-the-art technology in which technology levels are benchmarked in terms of specified machinery for each sector of Coir industry. Machinery with technology levels lower than that specified will not be permitted for funding under the TUF scheme.

Eligible Borrowers	Sole Proprietorships, Partnerships, Co-operative Societies, Private/Public limited companies. • Existing units with or without expansion and new units • Existing units proposing to modernize and/or expansion with state-of-the-art-technology • New units which are being set up with appropriate technology
Quantum Of Loan & Mode Of Assistance	Assistance shall be need based and NO CEILING on project cost/amount of loan. Assistance shall be by way of Term Loan.
Margin	15 to 25% of the project cost
Security	1st charge on fixed assets financed under the scheme Additional security such as personal guarantees, pledge of promoters share holdings as determined by Bank on merits of the case
Incentive Available Under The Scheme	Interest Reimbursement at the rate of 5% of the interest payment made by the unit to Bank on the loan outstanding. No Interest Reimbursement will be available for the extended period of loan or during the NPA status of the loan.
Repayment	Within 7 years including moratorium up to 1 year

APPENDIX – 3
Name and Address of Audited Units in the Cluster

Industry Name	Address	Contact Person	Contact Number
N.C Johns & Sons (P) Ltd	Thumpoly, Alleppey, Kerala	Sathyam	9847461982
N.C Johns & Sons (P) Ltd	Pathirapally, Alleppey, Kerala	Shashank	
N.C Johns & Sons (P) Ltd	Kalavoor, Alleppey, Kerala	Mickel Theodore	0477-2258041
N.C Johns & Sons (P) Ltd	Pathirapally, Alleppey, Kerala	Jacob Joseph	9447124223
N.C Johns & Sons (P) Ltd	Valavanadu, Alleppey, Kerala	Paul	0477-2862481
N.C Johns & Sons (P) Ltd	Vazichery, Alleppey, Kerala	Jacob	0477-2258041
Devi Coir Works	Krishna vilas, Mannanchery, Alleppey.	P.K. Devaraj	0477-2232433
Alleppey Company	Puthangadi, Muhamma PO, Alleppey	Suresh Kumar	9846959358
Kerala Balers PVC Unit	A.S. Road, Alleppey, Kerala	Mendez	0477-2243454
William Good Acres	P.B No. 4606, Alleppey.	Krishna Kumar	9847734450
Foam Matting	P.B No. 4619, Alleppey.	Senthil Prakash	9895109888
Palm Fiber	Pathirapally, Alleppey, Kerala	Saroja Devi	
Venice Coir Matting	Kalavoor, Alleppey, Kerala		
Coir Fed RPC Unit	Jubilee Road, Alleppey.	Shyam	9847461982
Vasudevan	Muppaparambil, Muhamma, Alleppey.	Vasudevan	0478-2863655
Babu Coir Works	SreeDodhanam, Mannenchery CPOL, Alleppey.	V.M. Babu	
Manesh Coir Works 2	ShylaiaBhavan, Monnonchery, Alleppey.		0477-2292021
Aneesha Coir Works	Kanniparambil, Mannanchery, Alleppey.		
Coirfed RB Unit	Jublee road, Alleppey 06.	Shyam	9847085445
Hindustan Coir Board	Kalavoor, Alleppey, Kerala	Unni Krishnan,	
Sandeep Coir Works	SowmyaNiwas, Pattankadu Post, Cherthala, Alleppey, Kerala		9249306150
Ramesh Coir Works	Panaparbathu, Pattankadu, Alleppey.	Ramesh	9037732257
Baiju Coir Works	Astharalaya, Mannanchery, Alleppey.	Baiju	
Mohan Das Coir Works	Theggil, Monnonchery, Alleppey, Kerala	Mohandas	0477-2291195
Gopika Coir Works	Thayyil,Monnonchery PO, Alleppey.	Omana Kuttan	9544176708
Babu Coir Works	SreeDodhanam, MannencheryCPOL, Alleppey.	V.M. Babu	
Gangadharan Coir Works	Mathu Puruthu, Monnonchery PO, Alleppey, Kerala	Gangadaran Sabu	0477-2290405
Kannon Coir Works	Undachanveedu, Monnonchery PO, Alleppey, Kerala	Mohan Das	
Tomco Industries	Ashramam Ward Junction, Alleppey 06, Kerala	Joseph Thomas	9895892189
Manesh Coir Works 1	Shylaia Bhavan, Monnonchery, Alleppey		0477-2292021
Jijil Coir Works	Krishnavilasam, Mannanchery, Alleppey		9744990774
Rohan Coir Works	Kummady House,Poonthuward, Alleppey	Anil	
Linu Coir Works	Kurusingal, Kanjiram Chira, Alleppey	K.A. Robert	
Yesudas Coir Works	Arresserriyil, Kanjiramchira, Alleppey		
Joy Coir Works (Kanjiram Chira)	Kochikarnveedu, Kanjiram Chira, Alleppey	K.C. Allosyions	9446170241
Papular Coir Works	Vadakkeparambil, kanjiramchira, Alleppey	P. Saseendran	9746200462
K.J. Jacob Coir Works	Kallaparambil, Kanjiramchira, Alleppey		
Muradalidharan Coir Works	Miruthala Nivas, Pattanavadu, Cherthala, Alleppey, Kerala		

Industry Name	Address	Contact Person	Contact Number
Natrajan Coir Works	Avattathil House, Pattanakadu PO, Cherthala, Alleppey, Kerala	V. Natraj	
Aravind Coir Works	Maravatival, Pattinauadu, Alleppey, Kerala	K.M. Aravind	9249428286
Anakha Coir Works	North aryad, Alleppey, Kerala	Manoj	
Supreem Coir Works	Avalookunnu PO, Alleppey, Kerala	V.A. Joseph	9447234884
Narayana Coir Works	Aryad, Avalookunnu PO, Alleppey	Jayanthi	0477-2258371
Minu Coir Works	Avalookunnu PO, Alleppey, Kerala		0477-2234884
Bindu Coir Works	Puthuparambu Chiva House, Muhamma, Alleppey, Kerala	Hari	9846144321
Anil Coir Works	North Aryad, Alleppey, Kerala	K. A. Anil Kumar	9020246378
Arun Coir Works	Panadrachirayil, Veetupanakachira, North Aryad P.O, Alleppey, Kerala	C. Sasidharan	
Beena Coir Works	Vadakke Kochu Tarayil, North Aryad, Alleppey, Kerala	D. Baiju	
K.J. Sampson Coir Works	Kallaparambil, Kanjiramchira, Alleppey		
Sarath Coir Works	Thekiniyadathis, North Aryad PO, Alleppey, Kerala	Siva Rajan	9447545827
Canal Coir Works	Chettighat, Pathirapally PO, Alleppey	Jaya Kumar	0477-2243380
Coir Tex	Thumpoly PO, Alleppey, Kerala	John. P.G	0477-3290840
Jiji Coir Works	Vazichery PO, Alleppey, Kerala	Vama Devan	0477-2246148
Jose Coir Works	Near Vazichery PO, Alleppey, Kerala	Jose	9446087488
Joseph & Sons Shearing Factory	Near vazichery, Alleppey, Kerala	Joseph	
Punnama Coir Works	Thumpoly PO, Alleppey, Kerala	Vinod	9846782962
South Region Coir Industry	Ashramam Ward Junction, Alleppey	Rajeev	0477-2232287
Vinayaka Coir Works	Thumpoly PO, Alleppey, Kerala	Vinodh	9946006468

APPENDIX – 4

Unit Wise Annual Consumption of Fuels and Electricity, Electricity Saving, Fuel Saving and Monetary Saving

S. No	Industry Name	Electricity Consumption (kWh / Annum)	Fuel Consumption (Tons / Annum)	Total Energy Consumption (Rs. Lakh / Annum)	Fuel Savings (Tons / Annum)	Electricity Savings (kWh / Annum)	Monetary Saving (Rs. Lakh / Annum)
1.	N.C John & Sons (P) Ltd.	2,02,104	2,016	50.4	272 tons	1,05,523	13.39
2.	N.C John & Sons (P) Ltd.	65,400		3.3		49,682	2.47
3.	N.C John & Sons (P) Ltd.	60,000		3		40,912	2.03
4.	N.C John & Sons (P) Ltd.	62,496	576	14.6	107 tons	31,221	4.77
5.	N.C John & Sons (P) Ltd.	49,265		2.5		44,935	2.19
6.	N.C John & Sons (P) Ltd.	54,144		2.7		26,018	1.28
7.	Devi Coir Works						
8.	Alleppey Company	1,99,395	825	26.5		70,108	31.22
9.	Kerala Balers PVC Unit	3,29,838	2,75,000	112.7		85,152	58.29
10.	William Good Acres	4,42,920	3,71,250	152.1		2,53,488	90.84
11.	Foam Matting	2,94,804	2,01,600	85.3		1,00,423	48.05
12.	Palm Fiber	75,566		3.8		16,051	0.79
13.	Venice Coir Matting	24,000	45	2.1	27	1,760	3.63
14.	Coir Fed RPC Unit	2,99,220	1,152	38.0		1,18,353	5.89
15.	Vasudevan	9,800		0.5		5,276	0.26
16.	Babu Coir Works	800		0.04			6.45
17.	Manesh Coir Works 2						0.84
18.	Aneesha Coir Works						1.56
19.	Coired RB Unit	10,800		0.5		900	0.04
20.	Hindustan Coir Board	29,438		1.5		22,260	1.1
21.	Sandeep Coir Works	560		0.03			
22.	Ramesh Coir Works	450		0.02			
23.	Baiju Coir Works	560		0.03			
24.	Mohan Das Coir Works	700		0.04			
25.	Gopika Coir Works	780		0.04			
26.	Babu Coir Works	800		0.04			
27.	Gangadharan Coir Works	635		0.03			
28.	Kannon Coir Works	900		0.05			
29.	Tomco Industries	24,000		1.2		3,600	0.18

30.	Manesh Coir Works 1						
31.	Jijil Coir Works						
32.	Rohan Coir Works		75	1.5	39		5.28
33.	Linu Coir Works						
34.	Yesudas Coir Works	195		0.01			
35.	Joy Coir Works (Kanjiram Chira)	600		0.03			
36.	Papular Coir Works						
37.	K.J. Jacob Coir Works						
38.	Muradalidharan Coir Works						
39.	Natrajan Coir Works						
40.	Aravind Coir Works	680		0.03			
41.	Anakha Coir Works			0.0			
42.	Supreem Coir Works		90	1.8	65		5.8
43.	Narayana Coir Works		60	1.2	27		8.04
44.	Minu Coir Works		75	1.5	51		6.27
45.	Bindu Coir Works	680		0.03			
46.	Anil Coir Works						
47.	Arun Coir Works						
48.	Beena Coir Works						
49.	K.J. Sampson Coir Works						
50.	Sarath Coir Works	340		0.02			
51.	Canal Coir Works	8,040		0.4		2,465	0.12
52.	Coir Tex	9,600		0.5		3,721	0.18
53.	Jiji Coir Works	12,000		0.6		3,648	0.18
54.	Jose Coir Works	9,200		0.5		2,275	0.11
55.	Joseph & Sons Shearing Factory	9,400		0.5		1,950	0.09
56.	Punnama Coir Works	8,200		0.4		4,371	0.21
57.	South Region Coir Industry	12,000		0.6		1,432	0.07
58.	Vinayaka Coir Works	7,200		0.4		4,477	0.22

LIST OF REFERENCES

1. Energy Audit reports of various companies
2. Records of the industries and energy bills
3. Equipment / technology suppliers – quotations and technical specifications
4. SIDBI Website
5. Andhra Bank Website