SPINNING OF COIR BLENDED YARNS IN JUTE SPINNING SYSTEM

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Abstract

Treating coir fibres with Caustic soda and after treatment with Magnesium chloride help to soften Coir fibres. SITRA has developed a new method to measure the rigidity of plant fibres like coir, sisal etc. Results on fibre rigidity obtained using the newly developed SITRA method, compares favourably with that obtained in the classical ring loop method. Chemical softening of coir fibres shows a tendency to reduce the linear density of the fibres and to improve the breaking elongation. To make conventional jute spinning machinery suitable to spin coir-blended yarns, appropriate modifications were carried out in breaker card, finisher card, gill drawing machines (3 passages) and flyer spinning machine.300 mm cut length was found optimal for blending coir with other fibres like jute, sisal or hemp. Runnage of two ply 100% coir yarns produced by automatic spinning machine used in the coir system ranges from 50 to 300 m/kg. In case of modified jute spinning process, the maximum runnage of 2 ply yarns obtained is 436 m/kg for coir/jute blended yarn, 395 m/kg for coir/hemp blended yarns and 380 m/kg for coir/sisal blended yarns. The modified jute spinning process helps to produce coir blended yarns of 25 to 45% finer as compared to 100% coir yarns produced by automatic spinning process used in the coir industry.

1.0 INTRODUCTION

Coir fibres are elastic resistant to seawater and also have high tear and abrasive strength. The biodegradable nature of coir fibres could help to raise the demand for coir products in the European markets in view of the growing concern for the environment in Europe.

1.1 World's Coir Fibre Industry

Coir is an important natural fibre creating a great deal of employment in villages in the coconut growing areas of the world such as India, Indonesia, Philippines, Thailand and Srilanka.

A brief profile of some of the common products that are manufactured in Sri Lanka and Thailand using coir fibres are given below:

- Coir Twine

  Made out of coir yarn (2 ply) with 2 cotton or synthetic threads twisted for additional strength & durability

- Marine Twine
- Grow Bags

Coco peat is highly compressed and supplied in polysleeves. This is an excellent growing medium. Fermented (composted) cocopeat is also used in the manufacture of Grow Bags.

- Coir Safety Fence

This is made of orange/red colour coir twine woven into 4" wide mat. The coir safety fence is not only biodegradable but also wild life - friendly. The twine in coir safety fence move independently providing opportunity for easy wild life movement.

- Coir Liners for wire baskets

Both moulded coir liners & needle punched coir liners are manufactured. These coir liners provide excellent drainage and aeration.

- Coir Dust for promoting plant growth

It is the left over dust after extraction of fibre from freshwater curled coconut husks. After extraction of fibre, coir dust is stored in open air for 2 – 3 years before use. Exposure to natural conditions, weathers coir dust and reduces its salinity and conductivity. Aged coconut dust has properties suitable for promoting plant growth.

- Coir-Fibre Pots

These are natural pots for growing indoor plants. They do not cause any damage to roots during trans-plantation.

- Coir Wattle for Flower bed edges

These are generally of 5" diameter. These wattles allow water to go through them and retain all the mulches within the flowerbed.

- Rubberised-Coir Padding / Mattress Padding
- Coir slit fence

This is woven from machine twisted bristle coir twines. These fences effectively filter run-off water and retain large particles. The heavy weight & high strength of coir will prevent the fence from falling off. Coir slit fence is easy to install, aesthetically pleasing and can be left in the field upon completion of construction.

- Fancy decorated door rugs

- Woven mattress coir blanket

This blanket is used for erosion control and vegetation establishment and has functional longevity of around 3 years.

- Turf reinforcement Mats

The high tensile strength & low elongation of these mats combined with three-net-structure provide high shear stress resistance without extensive stretching when subjected to heavy flow conditions.

- Geo Turf

It is a ready to use plant-growth structure made out of a mix of compressed coir dust, ground coconut husks and activated carbon in a matrix of rubberized coir

- Stuffed coir Revegetation / Sediment trap pillow

This is composed of a 2" thick pad of mattress fibre enclosed in woven blanket. The mattress coir pad holds seeds in place and provides a suitable medium for germinating seeds. This pillow is also an effective sediment trap in waterways.

In Europe, automatic looms are extensively used for weaving coir products. A coir weaver in Denmark has installed the World's first computer-aided rapier loom, which is of 2 m width.

1.2 Coir Fibre Industry in India

Coir Industry in India manufactures yarns, mats & mattings and other products using age-old processes due to which the Quality of the products leaves much to be desired. SITRA's observations/views on some of the processes adopted in the Indian Coir Industry at present are as follows:

Spinning

Spinning is mostly done manually. The output is low and the nature of work is tiresome. Mechanised ratts are available, but in most of the cases, the quality of yarns from these ratts does not conform to the exporter's quality requirements.

Majority of the coir yarns spun using mechanized ratts are manufactured with cotton or polyester filament as core. Whenever cotton is used as core, the cost of the resultant coir yarn increases and when polyester filament is used as core, the eco-friendly nature of the coir product is affected.

Weaving

Majority of coir mats and mattings are manufactured in handlooms. Automatic looms are sparingly used in the coir industry. It is mainly due to the exorbitantly high cost of the automatic looms. At present, automatic looms for coir weaving are not manufactured indigenously and they are only imported. Development of heavy-duty cost effective looms will provide a solution for manufacturing better quality mats and mattings at a relatively lower cost.

Dyeing and Bleaching

Even though some of the exporters have modern dyeing and bleaching facilities with effluent treatment plants, majority of the dyeing and bleaching activities are carried out with lower level of technology. There is scope for setting up better dyeing and bleaching houses at least in the case of medium scale exporters/manufacturers.

Finishing

The finishing operations like shearing, stitching, stenciling, clipping etc. are done manually or by operating with lower level of technology. Clipping of the mats is performed by using a pair of scissors, which is cumbersome. Some of these processes could be mechanized for removing human drudgery and for improving product aesthetics.

2.0 OBJECTIVES OF THE STUDY

Coir Board, Kochi has requested SITRA to conduct a project on "Spinning of Coir Blended Yarns in Jute Spinning system". The major objectives of the study are :

— Exploratory investigations on softening of coir fibres using different chemical reagents

and

— Spinning of coir/jute, coir/sisal and coir/hemp blended yarns in jute spinning system with appropriate machinery modifications.

3.0 ADVANTAGES OF BLENDING COIR WITH OTHER FIBRES LIKE JUTE, SISAL AND HEMP

The Length/Breadth (L/B) ratio that determines the spinnability of a fibre1 is 30.0 to 40.0 for coir, around 140.0 for jute, 160.0 for sisal and 900.0 for hemp. Hence, blending of coir with jute, sisal and hemp will improve the spinnability by way of reducing the flexural and torsional rigidities. The linear density of coir fibre is around 35 tex whereas that of jute is around 5 tex, sisal around 20 tex and hemp 12 tex. Hence, mixing of coir with jute and sisal will help to spin relatively finer yarns, which in turn will improve the texture of the products made. Coir fibre has tenacity of around 15 g/tex (varies from 12 g/tex to 20 g/tex) as against 50 g/tex for sisal, 35 g/tex for jute and 40 g/tex for hemp. Hence, the coir-blended yarns will have relatively higher strength, which could be expected to improve the service life of the products made.

Sisal fibres are stronger, lustrous and easily dyeable to any shade. Blending of coir with sisal therefore, will help to improve the durability and the appeal characteristics of the end product. Moreover, sisal fibres have higher abrasion resistance with lower coefficient of variation as compared to that of coir. Hence, products made out of coir/sisal blends could be expected to have better wear life.

4.0 SOFTENING OF COIR AND SISAL FIBRES

4.1 Evaluation of Fibre Characteristics

Coir fibres are largely used in the manufacture of Yarn, Cordage and wide range of furnishings such as mats, mattings, rugs, carpets, cushioning, insulation and packaging materials. The physical properties and chemical compositions[2] of coir fibre are provided in tables 1 and 2 respectively.

Table 1 : Physical Properties of Coir Fibres

Property	Value
Length/Breadth Ratio (L/B)	95.0
Fineness (tex)	35.0
Tenacity (g/tex)	20.0
Breaking Load (kg)	0.45
Extension at break (%)	25.0
Flexural rigidity (dynes/cm^2)	200.0
Density (g/cc)	1.40
Porosity (%)	40.0
Moisture regain at 65% RH (%)	10.50

Table 2 : Chemical Composition Coir Fibres
(% by mass on dry basis)

Composition	Fibre from Old Nuts	Fibre from Young Nuts
Cellulose	43.44	32.86
Hemicellulose	0.25	0.15
Lignin	45.84	41.54
Pectic substances	3.00	2.75
Water soluble matters	5.25	20.00
Ash content	2.06	2.50

Due to the presence of high quantity of lignin, coir fibre is very hard. Because of the relatively lower Length/Breadth ratio*, spinning of coir fibres is rather difficult. Hence, softening of coir fibres is necessary to enhance their spinnability. Some research studies were conducted earlier to improve the softness of coir fibres. Padmanabhan C.V.[3] had tried with oil and water, Bhat J.V. et. al [4] had used micro organisms and Prabu G.N.[5] had used some organic & inorganic chemicals, to improve the flexibility of coir fibres. In all these experiments, flexibility of coir fibres has improved to some extent, but the improvement was not found sufficient to enhance the spinnability of coir fibres substantially.

Earlier, SITRA has conducted extensive trials on softening of pineapple leaf fibres (PALF) towards enhancing its spinnability[1]. Studies were also carried out to improve the spinning quality of jute by the action of enzymes and other bio-agents[6].

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* L/B ratio of cotton : 1300
  L/B ratio of Pine Apple Leaf Fibres : 450

The present study has been conducted with a view to achieve substantial reduction in the rigidity of coir fibres through appropriate softening which is essential for coir spinning through high speed spinning machinery.

4.2 Physical and Chemical Impurities present in Coir Fibres

Mechanically extracted & retted coir fibres were tested for the Length Distribution and presence of physical & chemical impurities using Analytical Methods[7, 8]. The results are given in Table 3.

Table 3 : Length Distribution and Impurities Present

in Coir Fibres

Parameter	Mechanically Extracted Coir			Retted Coir		
	% Mass	Std Dev.	CV%	% Mass	Std Dev.	CV%
Length (mm)						
Up to 50	16.26	2.78	17.11	12.58	1.76	13.97
51 – 100	35.91	5.38	14.98	23.67	1.32	5.59
101 – 150	26.86	1.87	6.97	26.73	3.57	13.37
151 – 200	16.39	2.91	17.72	25.24	2.61	10.32
> 200	4.57	2.56	56.01	11.78	2.37	20.15
Physical Impurities like sand particles, pith etc.	13.22	2.42	18.27	7.12	2.38	33.37
Chemical Impurities Chlorides as Cl^-,	0.72	0.27	37.91	0.27	0.07	25.72
Sulphates as SO_4^{2-}	0.94	0.36	38.69	0.55	0.16	29.67

Mechanically extracted coir fibres have physical and chemical impurities to the tune of 25%. However, in retted coir fibres, the extent of impurities is slightly low at around 18%.

Several softening trials were carried out using different chemicals & enzymes on Coir fibres. The softening chemicals and softening parameters were chosen keeping in view the Chemical composition and Physical properties of coir fibres. Some of the important trials undertaken are briefly described in table 4.

Table 4 : Softening Trials

Sl. No.	Name of the Chemical	Details of Trials
1.	Sodium Hydroxide	Concentration: 5%, 10%, 20%, 30% & 40% Temperature: 100^{o} C Time : 1 hr.
2.	Sodium Sulphite	Concentration: 5%, 10%, 20%, 30% & 40% Temperature: 100^{o} C Time : 1 hr.
3.	Sodium Carbonate	Concentration: 5%, 10%, 20%, 30% & 40% Temperature: 100^{o} C Time : 1 hr.
4.	Ammonia solution	Concentration: 5%, 10%, 20%, 30% & 40% Temperature: 100^{o} C Time : 1 hr.
5.	Sodium Hypochlorite	Concentration: 1 g/l, 5 g/l, & 10 g/l Temperature: 60^{o} C Time : 1 hr.
6.	Hydrochloric acid	Concentration: 1 g/l, 5 g/l, & 10 g/l Temperature: 60^{o} C Time : 1 hr.
7.	Sulphuric acid	Concentration: 1 g/l, 5 g/l, & 10 g/l Temperature: 60^{o} C Time : 1 hr.
8.	Turkey Red Oil	Concentration: 25 g/l, & 50 g/l Temperature: Room Temperature Time : 1/2 hr.
9.	Urea	Concentration: 25 g/l, & 50 g/l Temperature: Room Temperature Time : 1/2 hr.
10.	Pectinase (Enzyme)	Concentration: 5 g/l Temperature: 60^{o} C Time : 1 hr.
11.	Cellulase (Enzyme)	Concentration: 5 g/l Temperature: 60^{o} C Time : 1 hr.

Spinning trials were carried out for coir/jute and coir/sisal blended materials (30/70, 40/60 and 50/50) using all the chemical and enzyme treated fibre samples (as given in Table 4) in modified jute flyer spinning system[6]. Based on the performance of the spinning trials, following softening treatment was found optimum for coir fibres.

Name of chemical	:	Caustic Soda (Sodium Hydroxide)
Concentration	:	10%
Time	:	1 hr.
Temperature	:	Boiling

After caustic boiling, the fibres are washed, neutralised, treated with Magnesium Chloride (to retain the softness imparted to the fibres) and then dried.

SITRA has developed a simple method to test the rigidity of coir fibres. Using the newly developed method, chemically softened coir fibres as well as untreated coir fibres were tested for their rigidity. The method of determination of rigidity in the new method is shown in Figure 1.

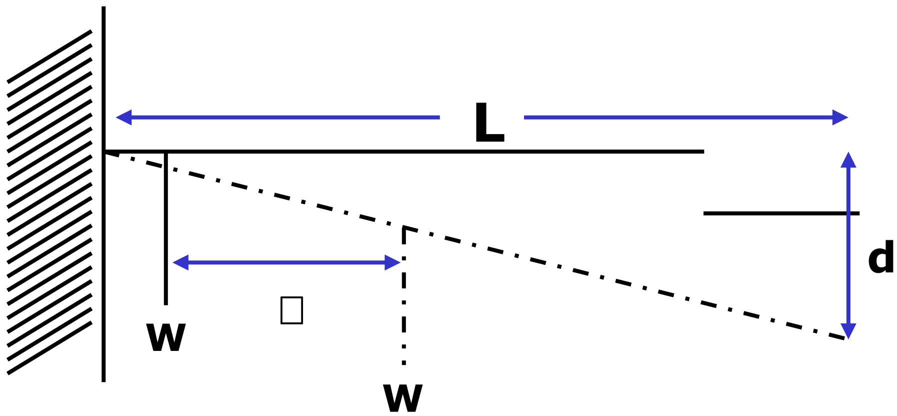


Figure 1 : Determination of Rigidity for Coir Fibres

L = Length of Coir Fibre = 40 mm	W = Weight placed on the fibre = 20 mg.
d = Deviation from straight path = 3 mm	□ = Displacement distance of weight 'W'

40 mm length of coir fibre (L) is mounted in a frame and a 20 mg of weight is placed at the base. The weight (W) is displaced slowly towards the free end of the fibre. For deviation of 3 mm (i.e. d) from original position, the displacement "□" is noted and the same is expressed as rigidity (mm).

4.3 Effect of Softening on Rigidity of Coir Fibres

The softened and untreated coir fibres are tested for rigidity by using SITRA's method and the results are shown in the figure 2.

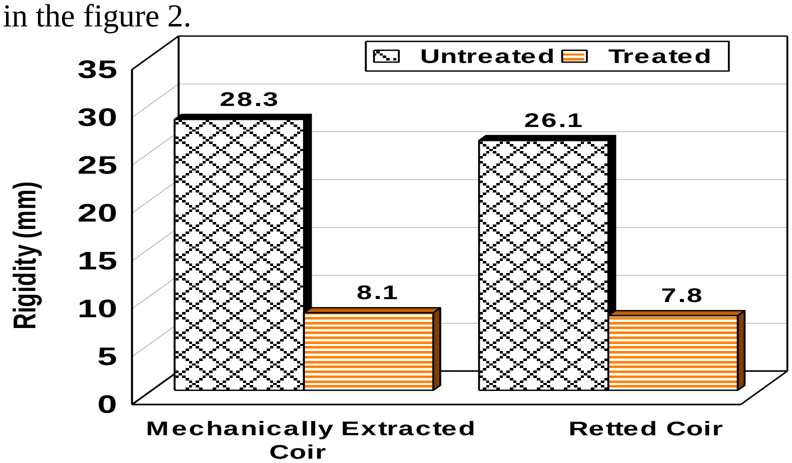


Figure 2 : Rigidity of Untreated and Treated Coir Fibres

The results show that the rigidity of coir fibres reduced due to chemical softening by about 70%.

Chemically softened coir fibres were also tested for flexural rigidity using the classical Ring Loop Method[9].

The result of flexural rigidity of coir fibres, obtained using Ring Loop Method is as follows.

Flexural Rigidity of Coir Fibres (gf.cm^2)

(i) Before Softening : 1.0793
(ii) After Softening : 0.4611

It is discernible from the above result that chemical softening reduces flexural rigidity of coir fibres by around 60%. These results compare favourably with that obtained regarding flexibility of coir fibres assessed using the newly developed SITRA method.

4.4 Effect of Softening on Fineness of Coir Fibres

Both mechanically extracted and retted coir fibres tend to become finer (Figure 3) by about 5% due to chemical softening. This may be due to the removal of some of the impurities present in the fibre during chemical softening.

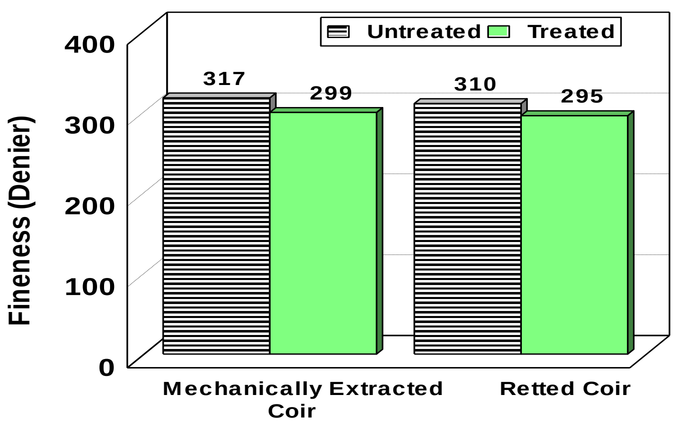


Figure 3 : Fineness of Untreated & Treated Coir Fibres

4.5 Effect of Softening on Breaking Elongation of Coir Fibres

The effect of softening on breaking elongation of coir fibre is shown in Figure 4:

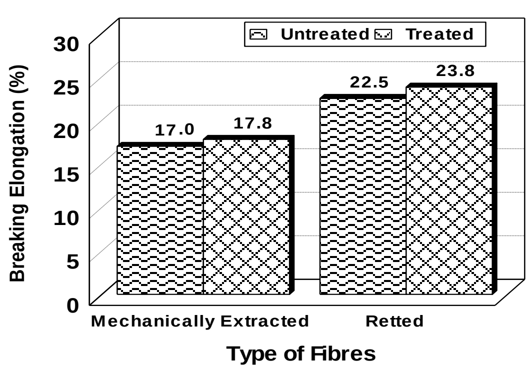


Figure 4 : Breaking Elongation of Untreated & Treated Coir Fibres

It is clear from the figure that chemical softening tends to improve breaking elongation of coir fibres, though marginally. This phenomenon of improvement in flexibility, fineness and breaking elongation may be due to the removal of lignin, swelling of fibres and the increase in moisture content of fibres.

5.0 SPINNING OF COIR/JUTE, COIR/SISAL AND COIR/HEMP BLENDED YARNS IN JUTE SPINNING SYSTEM

5.1 About Jute Spinning System

The most commonly operated jute spinning system[6] consists of two stages of carding, followed by three stages of drawing and finally a spinning stage. The flow chart is shown in Figure 5**:**

Jute Reed
|
Softening
|
Breaker Card
|
Finisher Card
|
Gill Draw Frame – I Passage
|
Gill Draw Frame – II Passage
|
Intersecting Gill Draw Frame – III Passage
|
Flyer Spinning Machine

Figure 5 : Process Flow Chart for Spinning 100% Jute Yarn

In the first carding stage, the long lengths of fibre are passed through a breaker card, which breaks the continuous mesh of fibres into separate fragments, conveniently called “entities”, which are akin to the single fibres of cotton and wool. In addition to fragmentation, the pins of the breaker card have a cleaning action by removing loosely adhering non-fibrous matter from the fibre proper.

Sliver from the breaker card is then passed through the second, or finisher card, which causes a little more fibre breakage and provides further opportunity for removal of non-fibrous matter. In addition, the finisher card has an important mixing effect, since a number of slivers are fed to the card in parallel and emerge finally as a single sliver

In the three drawing stages, the movement of fibre is controlled by gill pins fixed to faller bars. In modern drawing frames, the faller bars move on spiral screws, although some spinners prefer the push-bar method for the first stage. At all stages, drafting is accompanied by appropriate doubling of the input slivers.

The output sliver from the final drawing stage then passes to the spinning frame, where its linear density is reduced suitably for the yarn being spun, after which the required twist is inserted. Almost universally in the jute industry, the insertion of twist is performed by overhung flyer, with the yarn winding-on to a bobbin rotating on a dead spindle, against a friction drag. Other methods of inserting twist by ring or pot spinning are available but are little used, and then only for yarns of higher linear density.

The sequence of machinery used in Jute spinning system is shown in Figures 6 - 12.

Machinery Sequence in Jute Mills

Figure 6 : Softening Plant

Figure 7 : Breaker Card

Figure 8 : Finisher Card

Figure 9 : Gill Drawing Machine (I^{st} Passage)

Figure 11 : Gill Drawing Machine (3rd Passage)

Figure 10 : Gill Drawing Machine (2nd Passage)

Figure 12 : Flyer Spinning Machine

5.2 Modification of Jute Machinery to Spin Coir/Jute, Coir/sisal and Coir/Hemp Blended Yarns

The major machinery modifications that have been carried out in jute spinning system to make it suitable for processing coir-blended yarns are listed below:

1. Weight of crimping rollers was increased by about 20% for all preparatory machines (breaker card, finisher card and gill drawing – 3 Numbers).

2. The depth of slots for crimping rollers was increased from 1.0 mm to 2.0 mm in all preparatory machines.

3. The bush bearing system for all rotating parts of preparatory machines was replaced by ball bearing system.

4. New types of faller bars suitable for processing coarser varieties of fibres in gill draw frame were incorporated.

5. The top guides of flyers in jute spinning machine are made of chromium-plated steel. The same were replaced by ceramic guides for spinning coir blends.

6. Ceramic coating was also provided for other parts of the Flyer spinning machines in jute spinning system. This helps for better spinning performance while spinning coir blends.

7. The Flyer spinning machine used in jute spinning system is suitable for producing 100% jute yarns of runnage 3500 m/kg and 4500 m/kg. The gearing system of the same machine was modified for producing coir blended single yarns of runnage 400 m/kg to 1000 m/kg. Similarly, the driving system of twisting mechanism was altered, so that wide range of turns per unit of length can be imparted to yarn.

The process sequence of coir-blended yarns produced using modified jute spinning system is shown in Figure 6.

Coir/Jute (or) Coir/Sisal (or) Coir/Hemp

↓

Softening

↓

Breaker card

↓

Finisher card (2 passages)

↓

1st Gill Drawing

↓

2nd Gill Drawing

↓

3rd Gill Drawing

↓

Flyer Spinning

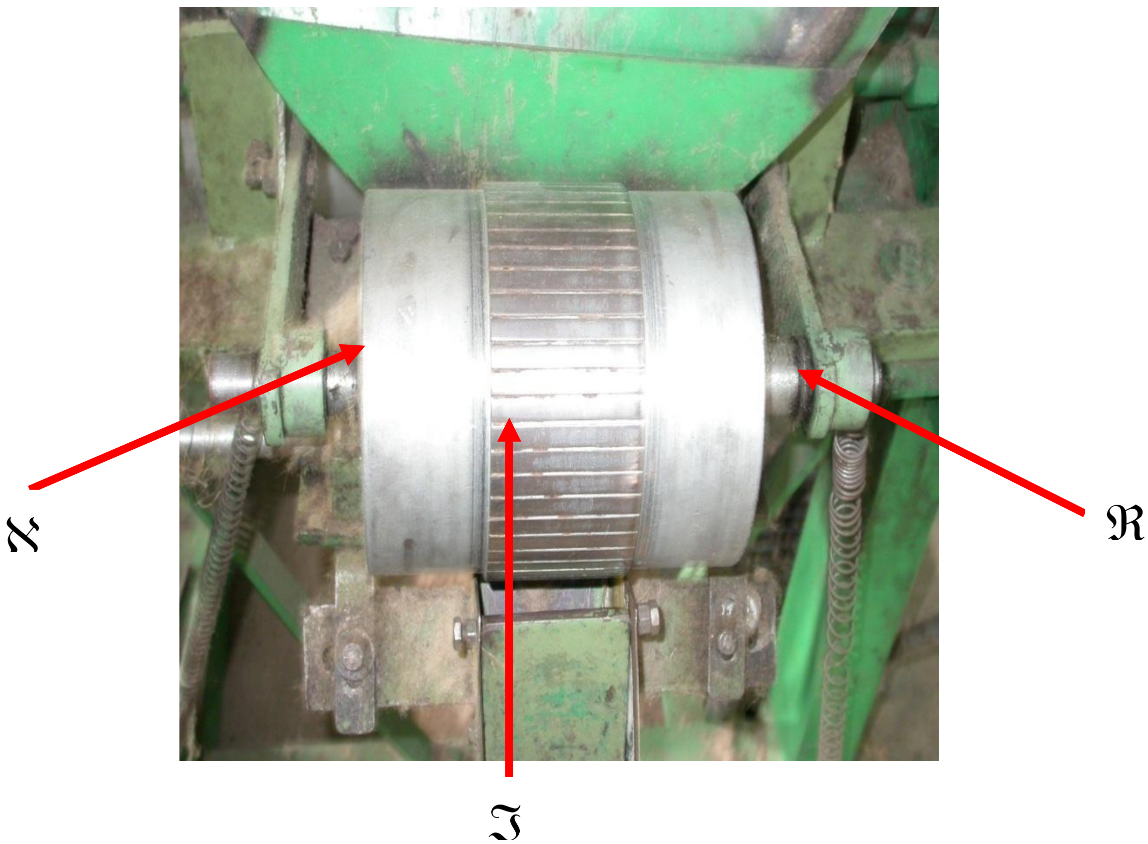
↓

Cheese Winding

Figure 13 : Machinery Sequence Used for Spinning Coir Blended Yarns

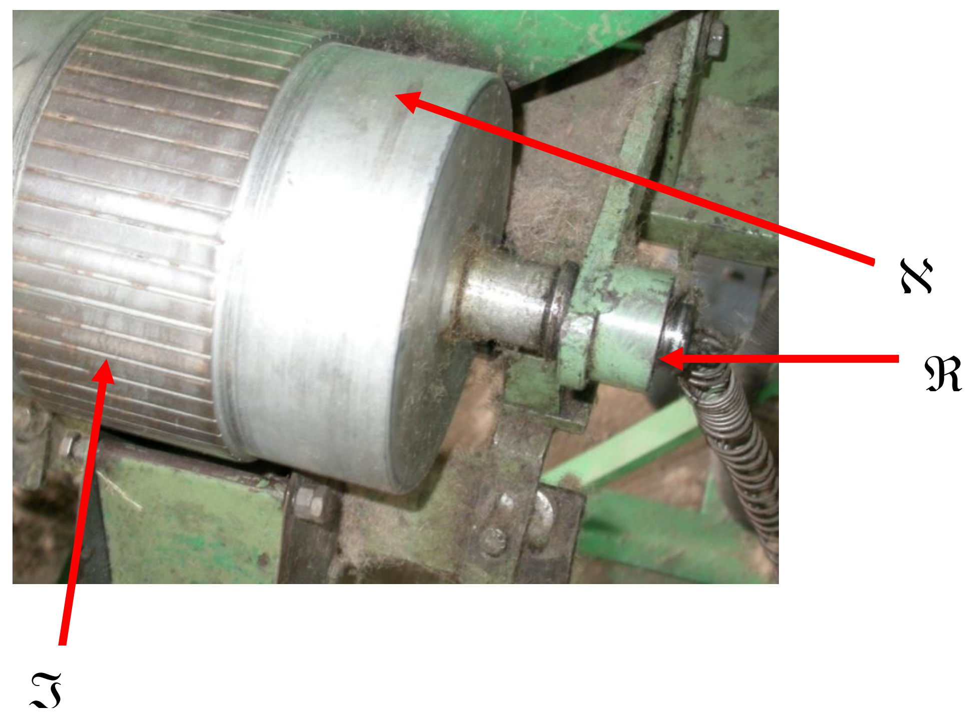
The modifications carried out in Jute spinning system to spin coir-blended yarns are given in Figures 14 – 19.

Machinery Modifications in Jute Spinning System to Spin Coir Blended Yarns



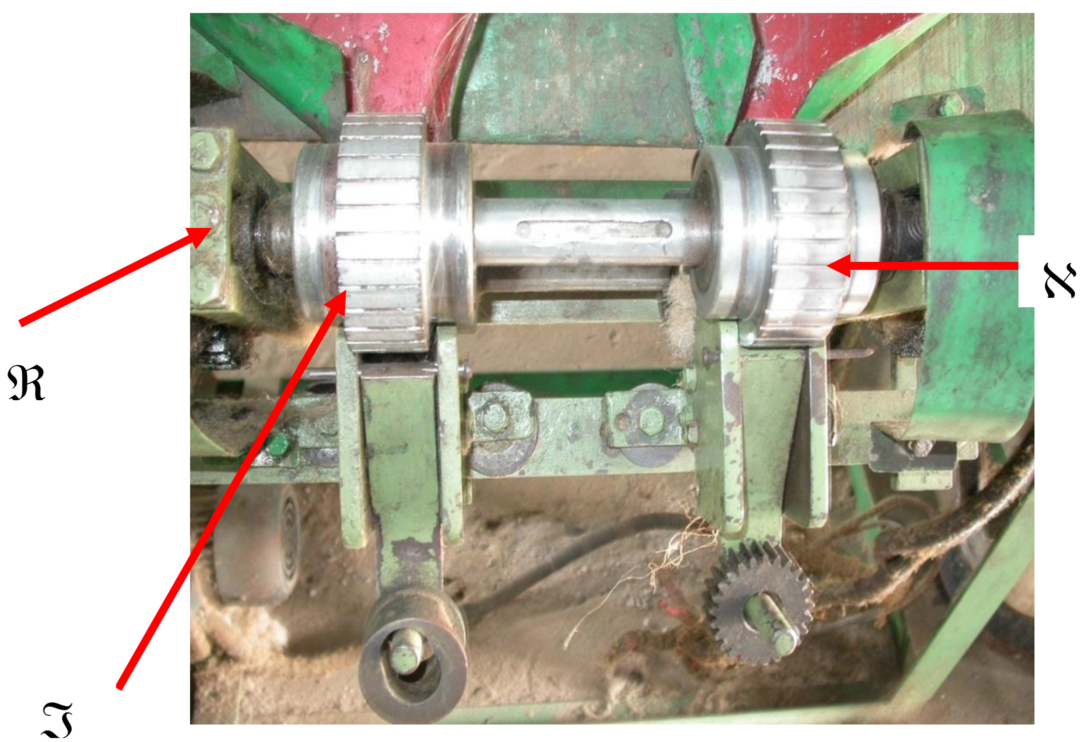
ℵ Increase in Weight of the Crimping Roller
ℵ Increase in the Depth of the Slots of Crimping Roller
ℜ Provision of Ball Bearings (instead of Bush bearing)

Figure 14 : Modifications at Breaker Card



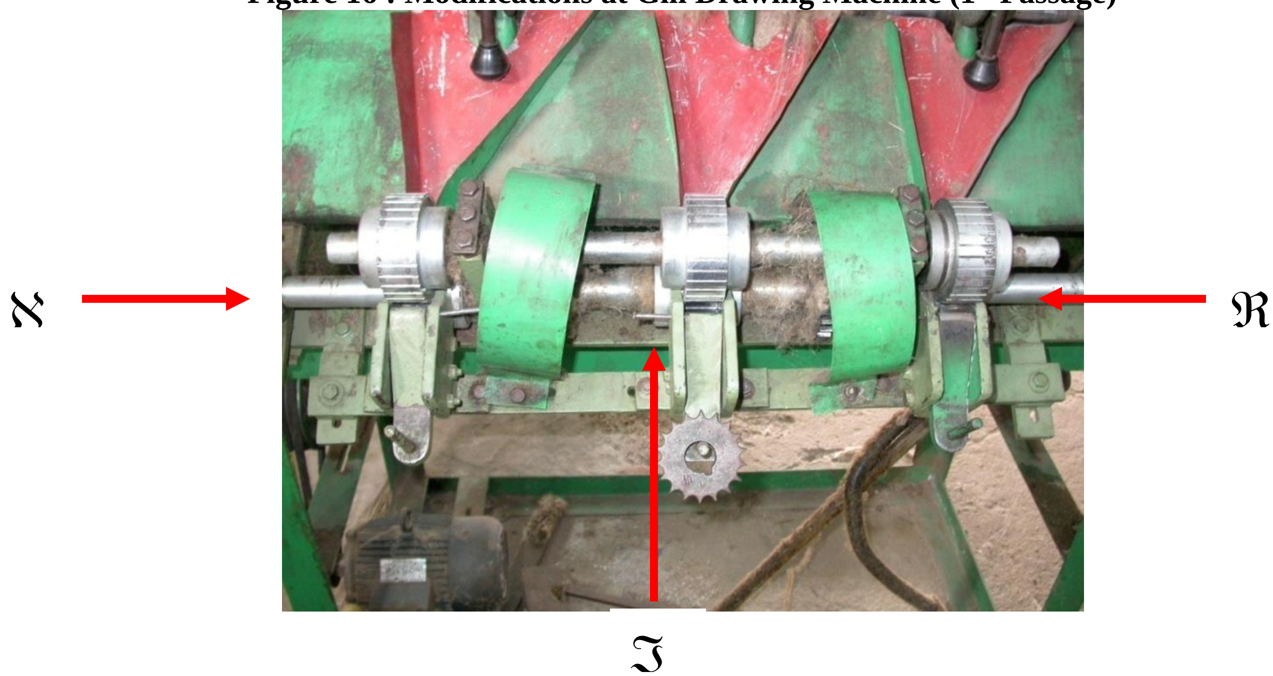
ℵ Increase in Weight of the Crimping Roller
ℑ Increase in the Depth of the Slots of Crimping Roller
ℜ Provision of Ball Bearings (instead of Bush bearing)

Figure 15 : Modifications at Finisher Card



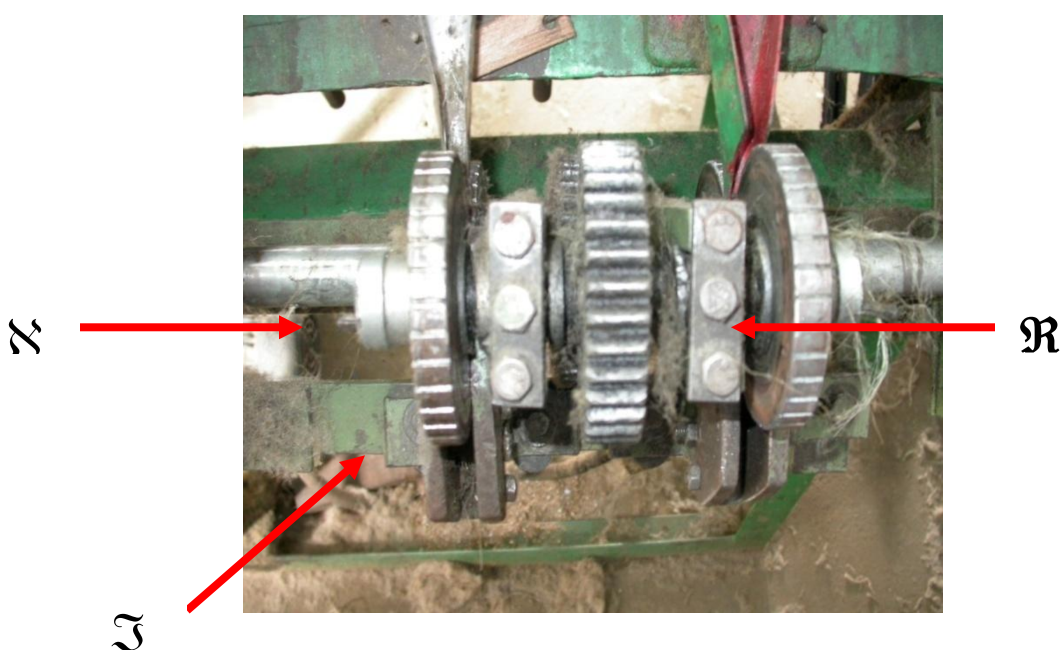
ℵ Increase in Weight of the Crimping Roller
ℑ Increase in the Depth of the Slots of Crimping Roller
ℜ Provision of Ball Bearings (instead of Bush bearing)

Figure 16 : Modifications at Gill Drawing Machine (1st Passage)



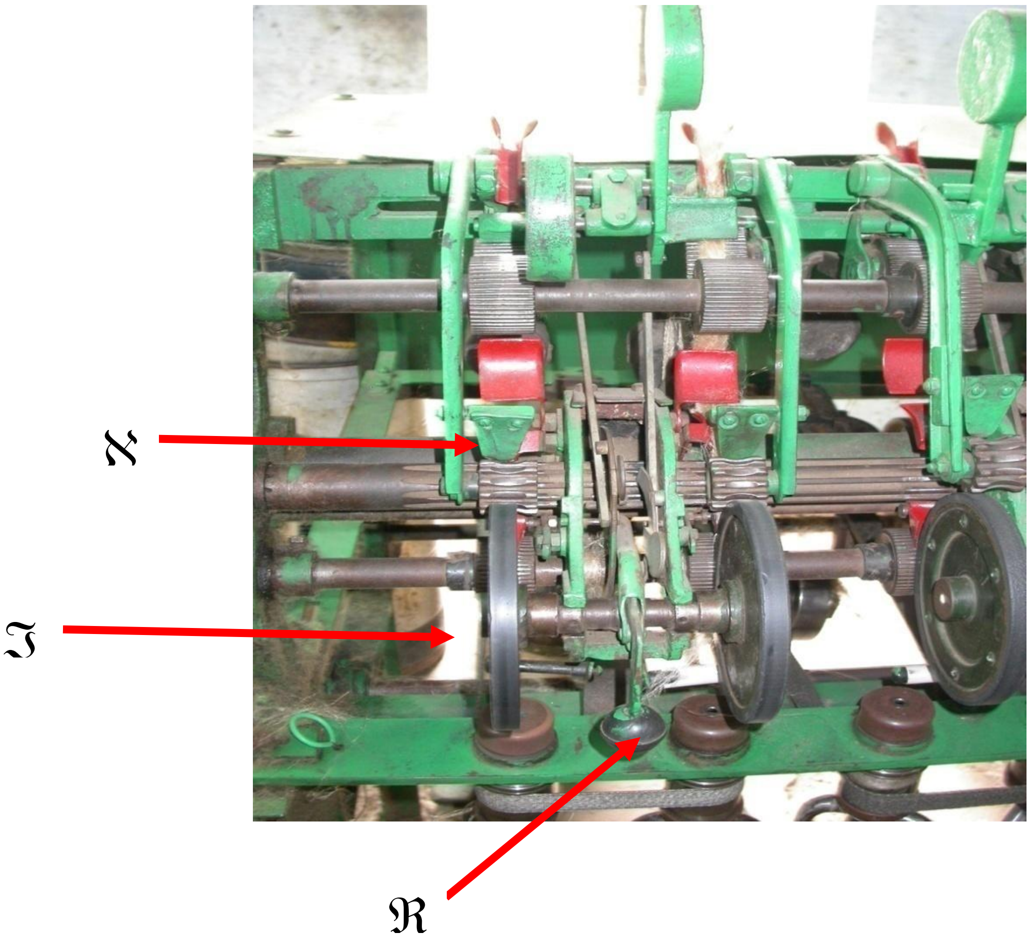
ℵ Increase in Weight of the Crimping Roller
ℑ Increase in the Depth of the Slots of Crimping Roller
ℜ Provision of Ball Bearings (instead of Bush bearing)

Figure 17 : Modifications at Gill Drawing Machine (2nd Passage)



ℵ Increase in Weight of the Crimping Roller
ℑ Increase in the Depth of the Slots of Crimping Roller
ℜ Provision of Ball Bearings (instead of bush bearing)

Figure 18 : Modifications at Gill Drawing Machine (3rd Passage)



ℵ Provision of Ceramic Guides
ℑ Provision of Ceramic Coating at Top Roller
ℜ Provision of Ceramic Coating at Flyer

Figure 19 : Modifications at Flyer Spinning Machine

5.3 Optimisation of Length for Jute and Sisal Fibres

Jute, sisal and hemp fibres are available in reed form with 4 to 6 ft. in length. Hence, for blending them with coir fibre, they have to be cut into appropriate length. The following trials were conducted for optimization of length of jute, sisal and hemp fibres meant for blending with coir:

1. Coir fibres have a wide variation in length (Table 5). Hence. Jute, sisal and hemp fibres were cut into 50 mm, 75 mm, 125 mm, 175 mm and 200 mm lengths.

Table 5 : Length of Coir Fibres

Length (mm)	Proportion (%)
Upto 50	16.0
51 - 100	36.0
101 - 150	27.0
151 - 200	16.0
Above 200	5.0

The fibres of variable length were mixed together and blended with coir. The coir/jute, coir/sisal and coir/hemp blended materials were processed in jute spinning system after incorporation of necessary modifications. But the working performance at Gill Draw frame (2nd and 3rd) and flyer spinning machine was found much inferior due to frequent breaks.

2. Some trials were also conducted with different fixed cut lengths i.e. 100 mm, 200 mm, 300 mm, 400 mm and 500 mm of jute, sisal and hemp fibres for spinning of coir/jute, coir/sisal and coir/hemp blended yarns.

Based on breakage rate at Gill drawing & flyer spinning machine and variation in weight per unit length of sliver, 300 mm fibre length was optimized for jute and sisal fibres.

5.4 Manufacture of Coir/Jute, Coir/Sisal and Coir/Hemp Blended yarns in Modified Jute Spinning System

Both coir and sisal fibres were softened using the standard procedure as discussed in earlier sections. Turkey red oil of 2.5% concentration was added to jute and hemp fibres and they were kept for 2 days for conditioning. Coir is mixed with jute, sisal and hemp fibres of 300 mm length (optimized fibre length for bulk spinning trials) and processed through breaker and finisher card. For proper blending two passages were provided at finisher card. The finisher card sliver is processed through three passages of Gill drawing frame for improving fibre parallelisation. In finisher carding and each Gill drawing machine, mechanized crimping (by slotted roller and over feed mechanism) is given at the delivery point to impart some sort of cohesion to the fibres in sliver. The 3rd drawing sliver is fed to the flyer-spinning machine for manufacturing coir-blended yarns.

The process parameters in modified jute spinning system to produce coir-blended yarns are given in Table 6:

Table 6 : Process Parameters in Modified Jute Spinning System

Gill Draw Frame	
1st Passage	No. of Doubling – 4 Draft : 6
2nd Passage	No. of Doubling – 4 Draft : 6
3rd Passage	No. of Doubling – 5 Draft : 8

Flyer Spinning	
Spindle Speed (rpm)	1000
T.P.I.	4.5
Ring Doubling	
Spindle Speed (rpm)	800
T.P.I.	2.5
Cheese Winding	
Delivery Speed (mpm)	200

The following coir blended yarns (ie. coir/jute, coir/sisal and coir/hemp) were produced (Table 7) after optimisation of softening process and spinning process along with machinery modifications. Doubling of coir blended yarns ie. coir blended with jute, sisal and hemp with equal blend proportion was carried out using ring doubling machine.

Table 7 : Coir Blended Yarns Produced in Modified Jute Spinning System

Sl. No.	Type of Blend	Blend Proportion (%)	Yarn Type	Runnage (m/kg)
1.	Coir/jute	50 / 50	Single	800
2.	Coir/jute	40 / 60	Single	1000
3.	Coir/Sisal	50 / 50	Single	800
4.	Coir/ Sisal	40 / 60	Single	900
5.	Coir/Hemp	50 / 50	Single	800
6.	Coir/ Hemp	40 / 60	Single	800
7.	Coir/jute	50 / 50	Double	385
8.	Coir/Sisal	50 / 50	Double	370
9	Coir/ Hemp	50 / 50	Double	380

The runnage of two ply 100% coir yarns produced by automatic spinning machine[10, 11] ranges from 50 to 300 m/kg. In the case of manual operation[12] (Hand spinning or spinning using traditional ratt) normally achieved runnage of 100% coir 2 ply yarn varies from 50 to 360 m/kg.

But in the case of modified jute spinning process, the achievable runnage of 2 ply yarns is 385 m/kg for coir/jute blend, 370 m/kg for coir/sisal blend and 380 m/kg for coir/hemp blend. Hence, the jute spinning process helps to produce coir blended yarns of 25 to 30% finer as compared to finest 100% coir yarns produced by automatic spinning process used in Coir Industries.

Tensile characteristics of coir blended two-ply yarns were evaluated as per Indian Standard IS 1670[13]. The results are provided in Table 8.

Table 8 : Tensile Characteristics of Coir Blended Yarns

Blend Proportion 50/50

Sl. No.	Type of Blend	Breaking Elongation (%)	Breaking Force (kgf)	Breaking Elongation (%)
1.	Coir/Jute	Single	15.50	8.5
2.	Coir/Jute	Double	20.25	10.25
3.	Coir/Sisal	Single	17.60	10.50
4.	Coir/Sisal	Double	22.00	13.50
5.	Coir/Hemp	Single	14.25	9.00
6.	Coir/Hemp	Double	18.75	11.00

The breaking strength and elongation of 100% 2-ply coir yarn (Anjengo Choriwal 380) of runnage 380 m/kg produced by hand spinning or wheel (ratt) spinning system are about 15 kg and 25% respectively. Hence, the breaking strength of coir blended double yarns produced using modified jute spinning system are higher by 25 to 35% in different blends. Due to addition of other fibres in blend (jute, sisal & hemp) having comparatively lower elongation value, the breaking elongation of coir-blended yarns produced is rather low. The breaking strength and elongation of 2 ply 100% coir yarn produced by automatic spinning system is comparatively higher. This is due to usage of polypropylene filament as core in the yarn geometry.

6.0 Manufacture of Mats using Coir Blended Yarns

Doormats were made using coir blended yarns as well as 100% coir yarns. Subjective Assessment of the softness of the mats was carried out by 10 independent judges.

All the judges, without exception have rated the mats made out of coir-blended yarns as superior as compared to mats made using 100% coir yarns.

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