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THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION
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AN OVERVIEW OF SITRA'S R&D WORK AND SERVICES - 2013-14

The year has been a rewarding one for SITRA with sustenance of its three core activities - research, consultancy services and training. As many as 30 research projects, with work relating to as many as one half completed during the year. The membership of SITRA at the close of financial year stood at 246 textile units comprising spinning mills, composite mills, fibre and machinery manufacturers, etc. Besides, 35 small scale textile units were availing services under Technical service card category. The needs of the powerloom and knitting sectors were being attended to through various service centres established at different locations of Tamilnadu. The total membership of SITRA now stands at 203 comprising of 246 units as against 202 members and 245 units last year. As far as finances are concerned, the year has been a satisfactory one.

Whatever success SITRA could achieve in its work and services to the industry has been largely due to the excellent response and encouragement from member organisation as well as support from the ministry of Textiles, through grants towards recurring expenditure, research projects and other schemes like ISDS. SITRA would like to express its gratitude to the Ministry of Textile and the member units for the cooperation extended by them.

The highlights of the research findings and work done in different areas are given below:

CONVERSION OF FIBRE TO YARN AND YARN TO FABRIC

A project was undertaken to study the inter-fibre cohesion in imported & indigenous cottons and its influence on yarn quality. Two imported and two indigenous cottons were taken for the study and they were spun into two counts of appropriate linear density. It was observed that there was a significant difference in the quality attributes, particularly in yarn imperfections (measured at normal sensitivity) between imported & indigenous cottons. The finisher drawing sliver samples were prepared from the four cottons (imported & indigenous) and their inter-fibre cohesion values were measured using Universal Tensile Tester (Instron). The inter-fibre cohesion was higher (around 30%) in slivers produced using imported cottons as compared to that from indigenous cottons. This is largely attributed to the relatively higher level of convolutions in imported cottons. Two experiments were carried out (using one Imported cotton and one Indigenous cotton) to identify optimum combination of draft (in fly frame & ring frame) from the point of view of yarn quality. In the case of imported cotton (with higher value of IFC in drawframe sliver) a relatively higher level of draft in ringframe and for Indigenous cotton (with lower value of IFC in drawframe sliver) a comparatively lower level of draft in ringframe (for a given level of total draft – Draft in flyframe x Draft in ringframe) would be appropriate from the view point of yarn quality, particularly imperfections.

OPERATIONAL STUDIES

One hundred and twenty three mills participated in the 29th inter-mill study on costs, operational performance and yarn quality (CPQ). This study covered the data for the 2nd quarter of 2013. The mills on the whole performed well by recording a huge increase in the contribution (by 26%) as compared to the 2nd quarter of 2012 which was mainly due to the substantial increase in the yarn sale value (by 18%). The increase in the sale value was contributed by the three parameters viz. increase in yarn selling price (by 35%), increase in ring frame machine productivity (by 37%) and coarser average count (by 28%). Raw material cost, a major component in the yarn cost, however, showed a substantial increase of 17% during this period. The other two cost components viz. power cost and salaries and wages cost also registered an increase of 10% and 15% respectively. Further analysis shows that out of the 94 common mills, three-fourths (71 mills) had registered an increase of Rs 1900 per spindle per year in the contribution, ranging from Rs 50 to Rs 9370 between mills. The remaining mills (23 mills) recorded a drop of Rs 850 per spindle per year in the contribution, ranging from Rs 20 to Rs 5650 between mills. It is interesting to observe that none of these 23 mills had earned a negative contribution.

SITRA had initiated a unique online monthly inter-mill study of RMC and YSP last year. During 2013-14, 11 studies were completed. As many as 100 mills, from different parts of the country, participated in the study conducted every month. The studies covered RMC, YSP, yarn quality, yarn realisation and ring frame production rate data of around 280 different counts and varieties of yarns with counts ranging from 4s to 120s, predominantly cotton counts. On 21st of every month, the respective survey reports, each numbering around 80 pages, were uploaded in the web portal "rmcysp.sitraonline.org". Since these survey reports are being made available only to the participants, that too online, for the benefit of non-participating mills, some information covered in the online reports, were brought-out as SITRA Focus and also published in leading textile journals.

SITRA had taken up a project on Compact yarn manufacturing. Spinning mills, towards improving their profitability, have been exploring both domestic and overseas markets to manufacture value added yarns. One of the value added yarns which is gaining importance in recent years, is compact yarn. During the last 5 years, the NOV, in terms of per kg and per spindle shift, had registered a two-fold increase in the case of 40s C-Comp. and 60s C-Comp. yarns whereas 80s C- Comp. yarn had recorded a 60% increase. Yarn realisation had remained unchanged in all the 3 counts (40s: 70%, 60s: 68% and 80s: 68%). In the case of production rate, 40s C-Comp. yarn registered a 4% increase whereas in 60s C-Comp. and 80s C-Comp. yarns, the production rate did not show any change (60s - about 68 g and 80s - about 43 g).

CHEMICAL PROCESSING

A project on comparative study of the dyeing behaviour of virgin and recycled polyester fibres was taken up by SITRA. As a preliminary trial, recycled polyester fibre samples and virgin polyester fibre samples were collected from the mills, dyed in fibre stage in the laboratory and assessed for their dyeability. Thermal characteristics of the raw fibres were also studied. There was a significant difference between the thermal behaviour of virgin and recycled polyester fibres. At 120° C to 130° C, there was a steep peak in the recycled fibre indicating the reorientation of polymers resulting in a higher order of crystallinity.

The results from the trial indicate that the recycled fibres dye darker than virgin fibres to the tune of say 15%. This difference can be attributed to the fact that there is considerable reorientation of molecules in recycled fibres.

MEDICAL / TECHNICAL TEXTILES

A project was undertaken on Development of wound dressings made of electro spun herbal drug and allopathic drug incorporated PCL nanomembranes and to compare the performance of the newly developed wound dressings with the commercially available wound dressings (CWD). Trials showed that there is a decrease in wound area with the application of the SITRA developed wound dressings. The extent of wound healing provided by the SITRA developed allopathic and herbal drug incorporated wound dressings was around 50% faster as compared to that while using CWD.

Another project on development of a leuko-depletion blood filter was undertaken. The objectives of this project were to develop a non-woven filter for removing leukocytes from blood and its components before blood transfusion and to filter the other impurities present in the blood components. Normally, 7% - 8% of human body's weight is from blood. Blood is a highly specialized tissue composed of more than 4,000 different kinds of components. Four of the most important ones are red cells, white cells, platelets and plasma. Leukocytes are white blood cells which the body produces to help fight off foreign substances in the body such as bacteria, viruses and abnormal cells in an effort to avoid sickness or disease. In the project, it was proposed to develop Leuko-depletion blood filters using sub micro denier polyester (PET) fibre, sub micro denier Nylon 6 (PA 6) fibres and sub micro denier polybutylene terephthalate (PBT) fibre. The process of preparation of web was done by using electro spinning (solution: melt form) and hydro entanglement process. Nine different combinations of trials were taken for each concentration of polymers and optimizing the process parameter in the basis of finer fibre diameter, since, finer the fibres will have better filtering efficiency.

INSTRUMENTATION

A project on design and fabrication of an instrument to assess the resistance of materials used in medical face masks to penetration against aerosol particles was undertaken. SITRA has designed and fabricated a particle filtration efficiency tester. The aerosol is the medium used to assess the particle filtration efficiency of the medical face masks. Aerosol is a suspension of solid or liquid particles in a gas. Four different types of nonwoven medical face masks were used in the process of calibration of the instrument that was fabricated in this project. The same face masks were tested in an accredited laboratory in the USA also (which regularly tests and certifies fabrics for their protection properties) for particle filtration efficiency.

Another project on design and development of an automated equipment to produce knotless incision closures was undertaken. The linear actuator which is to be incorporated into the equipment (to introduce barbs in monofilament sutures) was designed and fabricated. An automated high production equipment to produce knotless sutures was developed. The performance evaluation of the equipment is in progress.

CONSULTANCY SERVICES

Under specific requests from mills, SITRA attended to consultancy assignments on wide areas of specialisation. It is gratifying to note that the requests for consultancy services have been consistent from the mills in recent years. During the year, around 48 consultancy assignments were attended to.

Lead auditor certificate in the ISO 50001:2011 Energy Management System (EnMs)

SITRA is offering a consultancy service to textile mills based on Lead auditor certificate in the ISO 50001:2011 Energy Management System (EnMS). SITRA's energy division has staff well equipped and who have been certified as Lead Auditors by Bureau Veritas (I) Ltd., Chennai to conduct audits leading to the above certification. The scope of the consultancy service that is being offered to the mills as follows:

- Gap analysis.
- Energy audit base line fixing.
- Documentation and manual preparation.
- Internal audit.
- One day training programme to mill staff.

TESTING AND CALIBRATION SERVICES

SITRA's physical and chemical laboratories have been accredited by NABL for ISO / IEC - 17025 for the various fibre, yarn and fabric samples tested for their properties. Several mills exporting yarns are seeking SITRA test reports with NABL logo which provides an assurance of quality of the product. The year witnessed more than 61,050 samples of fibre, yarn and fabric being tested for their physical and chemical properties.

During the year, a total of 379 calibration certificates, in addition to 6 performance certificates were issued to 73 mills, for testing of quality control instruments. Testing the quality of spinning and weaving accessories / spares in order to select the right quality is another service being offered by SITRA. Over 1,450 samples covering various accessories like carton boxes, paper cones, rings and travellers, tubes, kraft papers, paper cores, worm & worm gear wheel, ring spinning spindles, cots, partition pad, etc., were tested.

SERVICES TO DECENTRALISED SECTOR

The services of the 7 powerloom service centres (PSC) in Tamil Nadu, managed by SITRA, were extensively used by the various units adjacent to the service centre. A total of 31,450 samples comprising of yarn and fabrics were tested and 1,056 persons were trained in the areas of loom maintenance, operation of shuttleless looms, calculation of fabric production, etc. The PSCs had also attended to 542 consultancy assignments and created 609 designs.

TRAINING

During 2013-14, SITRA conducted 8 different training programmes that were attended by 245 personnel in the supervisory and managerial cadres. Also, 2,275 operatives had undergone training during the year on right methods of working in textile mills for effective performance. Moreover, persons were trained under the ISDS of Ministry of Textiles, Government of India.

PUBLICATIONS

During the year, SITRA had brought out as many as 28 publications which included 11 online survey reports, 5 research / survey reports, 6 focus and 6 SITRA news. SITRA scientists also contributed 20 research papers to technical journals.

ORGANISATION

MEMBERSHIP

The membership of SITRA has shown a marginal increase during the year with the enrolement of 4 mills as members. SITRA is pleased to extend a warm welcome to the new members.

New members

1. Hindustan Cotton Spinning Mills, Coimbatore.
2. Nandhi Vardhana Textile Mills Limited, Guntur.
3. Sri Lakshmikantha Spinners Ltd., Andra Pradesh.
4. Shriganesh Textile & Infrastructure (I) Pvt. Ltd., Thane.

During the year, 3 member mills had relinquished their membership due to poor operating profits. The total membership of SITRA now stands at 203, comprising of 246 units (Table 1) as against 202 members and 245 units last year. SITRA's services were also utilised by 35 small mills under the Technical Service Card holders category. In all, 281 units had access to SITRA's services, apart from many small units in the decentralised sector which utilised the services offered by 7 Powerloom Service Centres, one Textile Service Centre, 4 CAD Centres, one Jute Promotion Centre and one Textile Testing Service Centre.

FINANCE

SITRA continues to maintain its financial health, registering surplus income for the year. The total recurring expenditure of SITRA during the year before appropriation from reserves was Rs 809 lakhs. The total income, including the grants from the Ministry of Textiles was Rs 829 lakhs.

SPONSORED PROJECTS

During the year under review, SITRA undertook 8 research projects sponsored by the Ministry of Textiles (MoT), Government of India and 1 project sponsored by the Department of Science and Technology, Government of India.

Work related to the following three projects, sponsored by the Ministry of Textiles, has been completed and the reports were submitted:

1. Development of wound dressings made of electro spun herbal drug and allopathic drug incorporated in PCL nano membrane.
2. Hospital bed linens with enhanced thermal properties.
3. Design and fabrication of an instrument to assess the resistance of materials used in medical face masks to penetration against aerosol particles using latex spheres.

Work relating to the following five MoT projects is in progress :

1. Development of textile matrices for the effective wound management.
2. Design and development of an automated equipment to produce knotless incision closures.
3. Development of a Leuko-depletion blood filter.
4. Development of collagen coated on hernia mesh.

Table 1 Region-wise membership

Region	Spinning mills	Composite mills	Fibre manufacturers, Machinery manufacturers and others	Total
SITRA zone	150	19	4	173
Other States	10	7	2	27
Overseas	2	1	-	3
Total members	170	27	6	203
Total units	193	47	6	246

5. Development of mopping pads using nonwoven and woven structure.

Work is in progress in the following DST project:

1. Development of self assembled peptide hydrogel based bioactive dressing material for chronic wounds

MACHINERY AND EQUIPMENT

SITRA has made large capital investments during the last decade to equip its laboratories with state-of-the-art machinery / instruments. Important machinery and equipment acquired during the year include, Schlafhorst Autocoro 360 - O.E. spinning machine (24 rotors), Soft flow dyeing machine, Induction Coupled Plasma - Mass Spectrometer (ICP-MS), High Performance Liquid Chromotography - Tandem Mass Spectrometer (HPLC-MS/MS), Total Organic Carbon (TOC) analyser, Melting point / Boiling point analyser, CSP system - 636, Uster Zweigle HL 4000 CPL, Colling Incubator, Fully automatic autoclave model-7431SLEA and Aerosol particle counter Lasair III.

STAFF

The total staff strength of SITRA during the year was 121, slightly lower than last year's strength of 127.

The staff strength of various service centres like PSCs, Textile service centre, jute promotion centre and textile testing and service centre was 46.

CONVERSION OF FIBRE TO YARN AND YARN TO FABRIC

STUDIES ON PROPERTIES AND PROCESSING PERFORMANCE OF BT- COTTONS

Introduction

Bt Cotton is the first genetically modified crop which guards it from the bollworm infestation. In India, Bt-Cotton cultivation was introduced during 2002 in the central and south zones followed by northern zone in 2005. It took nearly seven years in introducing and permitting the Bt cotton cultivation in India on the commercial level at larger scale. Since, 2002, GEAC (Genetic Engineering Approval Committee) has released about 270 Bt cotton varieties for commercial cultivation, developed by seed companies. In India, since 2002 the area under Bt cotton has been increasing sharply and now it has reached the level of around 90%. Nevertheless, not many studies are reported in literature regarding the fibre quality attributes of Bt cottons. Hence, SITRA has undertaken a project

- To study the fibre quality attributes of Bt cottons and compare the same with that of Non-Bt counterparts.

Quality attributes of Bt cotton

Fibre Strength

Bundle strength values of Bt cottons in 4 different length groups were evaluated and are given in Table 2 together with that of non-Bt counterparts.

Table 2 Bundle strength values of Non Bt & Bt cottons in different length groups

— Fibre strength values (g/tex)

Cotton length group (2.5 % span length – mm) \ Type of cotton	Non -Bt	Bt
27 – 28	25.0	21.5
29 – 31	26.0	22.0
31 – 33	28.0	24.4
36 – 38	32.0	29.0

Bt cottons are found to be weaker than their non Bt counterparts by roughly 10% to 15% in different length groups. In order to understand the reason behind this, the morphology of Non Bt & Bt cottons were studied for their crystallinity using X-ray diffraction (XRD) method. The relevant details are given in Table 3.

Table 3 Crystallinity Index of Non Bt and Bt cottons

- Crystallinity Index (%)

Cotton length group (2.5 % span length – mm) \ Type of cotton	Non -Bt	Bt
27 – 28	77.0	65.0
29 – 31	81.0	67.0
31 – 33	79.0	68.0

The crystallinity Index values of Bt cottons are found lower than that of non Bt cottons by 10% to 14% (absolute values). To quantify the relationship between crystallinity Index in cotton and the corresponding fibre strength, 8 cotton samples with different crystallinity Index values were procured from Tamil Nadu Agricultural University, Coimbatore and their tenacity values were estimated. The results are given in Table 4.

Table 4 Relationship between cotton fibre crystallinity and cotton fibre tenacity

Fibre Crystallinity Index (%)	Fibre Tenacity (g/tex)
54.0	25.5
55.0	27.0
57.0	28.0
62.0	30.5
65.0	31.0
66.5	32.0
67.0	33.0
69.0	35.0

Crystallinity Index in cotton & fibre strength values are highly correlated. The relationship is shown in Figure 1.

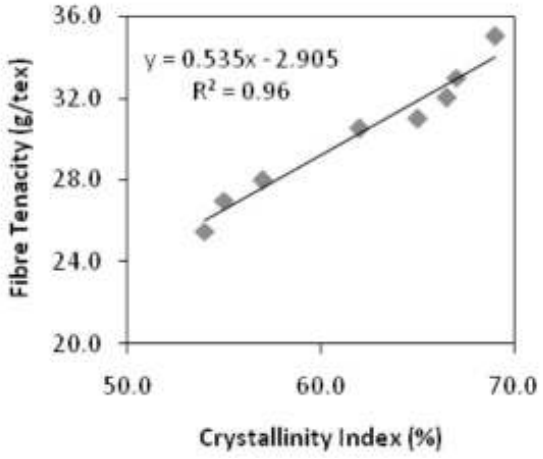


Figure 1 Relationship between crystallinity Index and fibre tenacity

The actual and predicted values of fibre tenacity are given in Table 5

Table 5 Actual and Predicted values of fibre tenacity

Cotton	Actual values (g/tex)	Predicted values (g/tex)	Difference in g/tex (%)
1	25.5	26.0	1.96
2	27.0	26.5	1.85
3	28.0	27.6	1.43
4	30.5	30.3	0.66
5	31.0	31.9	2.90
6	32.0	32.7	2.19
7	33.0	32.9	0.30
8	35.0	34.0	2.86

The average error of estimate is around 2%

Fibre Micronaire value

Micronaire values of Bt cottons in 3 different length groups were evaluated and are given in Table 6 together with that of non-Bt cottons in similar length groups.

Table 6 Micronaire values of Non Bt & Bt cottons in different length groups

— Micronaire value (µg / inch)

Cotton length group (2.5 % span length – mm) \ Type of cotton	Non - Bt	Bt
27 – 28	3.8	4.4
29 – 31	3.7	4.1
31 – 33	3.4	4.0

Bt cottons are found to be coarser than their non-Bt counterparts approximately by 0.5 Mic. value in different length groups. With a view to assess the relationship between crystallinity index in cotton and the corresponding Mic. value, the 8 cotton samples procured from Agricultural University were evaluated for crystallinity index and Mic value and the results are given in Table 7.

Table 7 Relationship between fibre crystallnity Index and Mic value

Fibre Crystallinity Index (%)	Fibre Mic value(µg/inch)
54.0	4.6
55.0	4.5
57.0	4.4
62.0	3.7
65.0	3.8
66.5	3.5
67.0	3.3
69.0	3.0

Crystallinity index in cotton & fibre Mic value are highly correlated. The relationship is shown in Figure 2.

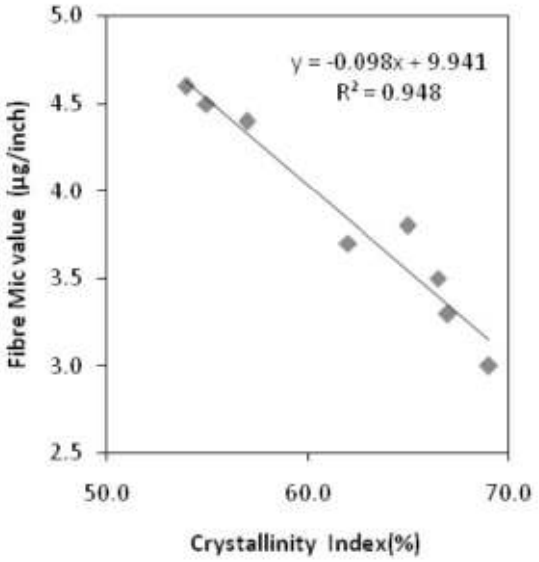


Figure 2 Relationship between crystallinity index and fibre Mic value

The actual and predicted values of fibre mic.value are given in Table 8.

Table 8 Actual and predicted values of fibre Mic value

Cotton	Actual mic value (µg/inch)	Predicted mic value (µg/inch)	Difference in mic value (%)
1	4.6	4.65	1.09
2	4.5	4.55	1.11
3	4.4	4.36	0.91
4	3.7	3.87	4.59
5	3.8	3.57	6.05
6	3.5	3.42	2.28
7	3.3	3.38	2.42
8	3.0	3.18	6.00

The average error of estimate is around 3%

Degree of polymerisation

The number of repeat units linked together to form the cellulose polymer is referred to as "Degree of polymerisation" (as illustrated in Figure 3).

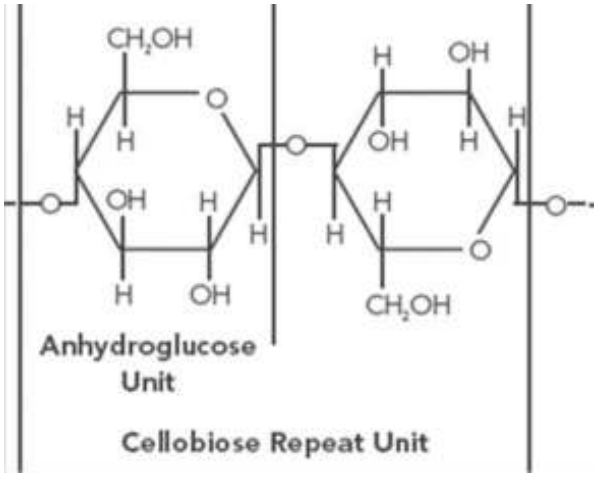


Figure 3 Chemical structure of cellulose

Higher degree of polymerisation (D.P.) is associated with higher fibre strength & vice versa. D.P. values of non-Bt & Bt cottons belonging to different length groups were estimated using "Fluidity Method" and the values are given in Table 9. The method is briefly explained below.

About 0.15g (on bone dry weight basis) of the sample is accurately weighed and transferred to a 250 ml Erlenmeyer Flask. X ml (120 X gms of cellulose in sample) of 0.167 M Cuen* followed in few minutes by Y ml (80 X gms of cellulose in sample) of 1.0 M Cuen are added in the flask. The air in the Erlenmeyer Flask is swept out by passing a brisk stream of purified nitrogen over the surface of the solution. The flask is tightly corked and vigorously shaken till the sample dissolves completely. The solution is drawn in a suitable Cannon-fenske viscometer and the efflux time at 20º ± 0.1 ºC is determined.

The time of flow (t) for aqueous glycerol solution having density 1.1681 g/cm^3 and fluidity 6.83 reciprocal poises at 20ºC is measured.

$$C = F \times d \times t$$

The observed fluidity F_0 is calculated as

$$F_0 = C/(d \times t_0)$$

Where,
C = constant of viscometer,
d = density of cupriethylenediamine solution (1.052 g/cc) and
t_0 = time to flow of the solution in seconds.

From the observed fluidity F_0, the fluidity (F_{500}) for the standard velocity gradient (500 sec^{-1}) is calculated using the formula :

$$\log F_{500} = A \pm \sqrt{A^2 - 2.25 + \frac{3.077 \log F_0}{\log G_0 - 2.7}}$$

where,

$$A = 1.5 - \frac{1.538}{\log G_0 - 2.7}$$

and G_0 is the velocity gradient for the solution , which is obtained from the velocity gradient – time constant of the viscometer G_t using the relation

$$G_0 = \frac{G_t}{t_0}$$

* Cuen - cupriethylenediamine

The velocity gradient – time constant G_t is calculated from the equation

$$G_t = \frac{8V}{9.425\ r^3}$$

Where,

V is the volume of the capillary and
r is the radius

These two components of the capillary are measured by using mercury.

If the fluidity values are to be expressed in terms of D.P. of cellulose, then

$$\text{Relative viscosity } (\eta_r) = \frac{\text{Viscosity of solution}}{\text{Viscosity of solvent}} = \frac{\text{time of solution}}{\text{time of solvent}}$$

is calculated and the following equation is used :

$$D.P. = 2160\ [\log (\eta_r + 1) - 0.267].$$

Table 9 D.P. values of non-Bt and Bt cottons in different length groups

Cotton length group (2.5 % span length – mm) \ Type of cotton	Non -Bt	Bt
27 – 28	2781	2544
29 – 31	2654	2306
31 – 33	2895	2654
36 – 38	1994	1775

D.P. values of Bt cottons are lower than that of their non-Bt counterparts by about 10% in different length groups. This could be one of the reasons for the relatively lower strength of Bt cottons.

Aflatoxins in Non Bt & Bt cottons

The aflatoxins are a group of chemically similar toxic fungal metabolites (mycotoxins) produced by certain moulds of the genus Aspergillus. Aflatoxins are highly toxic compounds and cause both acute and chronic toxicity in humans and many other animals.

Aflatoxin B_1 is a very potent carcinogen and a mutagen in humans. At high enough exposure levels, aflatoxins can cause acute toxicity, and potentially death, in mammals, birds and fish, as well as in humans. The liver is the principal organ affected, but high levels of aflatoxin can also impair lungs, kidneys, brains & hearts.

The European Union (EU) sets limits for aflatoxin B_1. Limits vary according to the commodity, but range from 2 – 12 µg/kg for B_1. Limits of 0.10 µg/kg for B_1 have been set for infant foods.

Aflatoxin levels in Non-Bt & Bt cottons belonging to different length groups are given in Table 10.

Table 10 Aflatoxin levels in non-Bt & Bt cottons

— Aflatoxin B_1

Cotton length group (2.5 % span length – mm) / Type of cotton		Non -Bt	Bt
27 -28	: Cotton 1	Nil	12µg/Kg
	: Cotton 2	Nil	12µg/Kg
29 – 31	: Cotton 3	Nil	Nil
	: Cotton 4	Nil	Nil
	: Cotton 5	Nil	12µg/Kg
	: Cotton 6	Nil	12µg/Kg
31 – 33	: Cotton 7	Nil	12µg/Kg
	: Cotton 8	Nil	Nil
	: Cotton 9	Nil	12µg/Kg
36 - 38	: Cotton 10	Nil	Nil

Six Bt cottons (out of 10 cottons covered in this investigation) have exhibited high levels of Aflatoxin content. This is a matter of concern. The project has been completed.

INTER-FIBRE COHESION IN IMPORTED & INDIGENOUS COTTONS AND ITS INFLUENCE ON YARN QUALITY

It is a common experience that some of the imported cottons exhibit better spinning performance and yarn quality as compared to their indigenous counterparts. To be specific, the major fibre quality attributes of two imported and two indigenous cottons (which are commonly used to spin 60^s Combed yarn & 40^s Combed yarn) are given in Tables 11& 12:

It is clear from the tables that the differences in major fibre quality attributes between imported & indigenous cottons (that are taken for the study) are rather marginal.

However, when they are spun into yarns of appropriate linear density, there are significant differences in quality attributes particularly in yarn imperfections.

Table 11 Quality attributes of imported and indigenous cotton

- 60^s Cotton

Fibre quality attributes / Cotton type	Imported (ULTIMA ACALA)	Indigenous (MCU -5)
2.5 % Span Length (mm)	32.0	31.5
Mic Value (µg/inch)	3.6	3.7
Uniformity Ratio (%)	46.5	46.0

Table 12 Quality attributes of imported and indigenous cotton

- 40^s Cotton

Fibre quality attributes / Cotton type	Imported Western African - Nambo's	Indigenous (S6)
2.5 % Span Length (mm)	29.5	30.0
Mic Value (µg/inch)	3.4	3.5
Uniformity Ratio (%)	46.6	46.0

Yarn quality details are given in Tables 13 &14:

Table 13 Quality attributes of yarns spun from imported and indigenous cottons

Count: 60^{s} CW

Count (Ne)	Yarn quality attributes				
	Single yarn strength CV (%)	Single yarn elongation CV(%)	Imperfections / Km		
			Thin places (-50%)	Thick places (+50%)	Thin + Thick places
60s CW from Imported cotton ULTIMA (ACALA)	8.69	11.76	2	16	18
60s CW from Indian cotton (MCU5)	9.16	12.12	10	26	36

Table 14 Quality attributes of yarns spun from imported and indigenous cottons

Count: 40^{s} CW

Count (Ne)	Yarn quality attributes				
	Single yarn strength CV (%)	Single yarn elongation CV(%)	Imperfections / Km		
			Thin places (-50%)	Thick places (+50%)	Thin + Thick places
40s CW from Imported cotton - Nambo's	9.78	10.68	8	39	47
40s CW from Indian cotton (S6)	11.55	12.82	11	59	70

The differences in yarn imperfections (measured at normal sensitivity levels) in 60s CW & 40s CW spun using imported & indigenous cottons could not be fully explained by the differences in the respective fibre quality attributes (that are commonly measured) Hence, the inter – fibre cohesion in imported & indigenous cottons was measured using Universal Tensile Tester (Instron) as per ASTM D 2612- 05 standard test method. The test method deals with measurement of inter – fibre cohesion in a bundle of fibres in the form of sliver or cop. Finisher drawing sliver samples were prepared from the four cottons (imported & indigenous) and their inter- fibre cohesion values measured. The values are given in Table 15.

Table 15 Inter fibre cohesion in drawframe slivers made using imported & indigenous cottons.

Sl.no	Sample	Inter- fibre cohesion (mgf / tex)
1.	Finisher sliver from ULTIMA AKALA cotton	28.0
2.	Finisher sliver from MCU5 cotton	22.0
3.	Finisher sliver from Nambo's cotton	25.7
4.	Finisher sliver from S6 cotton	20.0

It is clear that from Table 15 that inter-fibre cohesion is higher (around 30%) in slivers produced using imported cottons as compared to that from indigenous cottons.

An attempt was made to develop an index expressing the inter- fibre cohesion (in drawframe sliver) in terms of fibre properties for imported & indigenous cottons and the same is given by

$$\text{I) IFC*} = 33 \sqrt{\frac{2.5\ \%\ SL}{\text{Mic value} \times \text{SFC (n)}}} \quad \text{for imported cotton}$$

and

$$\text{I) IFC*} = 25 \sqrt{\frac{2.5\ \%\ SL}{\text{Mic value} \times \text{SFC (n)}}} \quad \text{for indigenous cotton}$$

* *IFC – Inter fibre cohesion*

This is largely attributed to the relatively higher level of convolutions in imported cottons. Convolutions are ribbon like twists which are produced during drying of the cotton cell content under the influence of Sun. As per the available information, Egyptian cottons have about 230 convolutions / inch, American cottons have around 190 convolutions / inch and indian cottons in the range of 125 – 130 convolutions / inch.

2 experiments were carried out (using one imported cotton and one indigenous cotton) to identify optimum combination of draft (in fly frame & ring frame) from the point of view of yarn quality i.e) Drafts in flyframe & ringframe were altered to have more or less same total draft for a given count and the corresponding yarn quality attributes studied. The parameters & quality attributes are given in Table 16.

In the case of imported cotton (with higher value of IFC in drawframe sliver) a relatively higher level of draft in ringframe and for indigenous cotton (with lower value of IFC in drawframe sliver) a comparatively lower level of draft in ringframe (for a given level of total draft – Draft in flyframe x Draft in ringframe) would be appropriate from the view point of yarn quality, particularly imperfections.

It is postulated that higher level of draft in ringframe for materials with higher IFC is necessitated for effective removal of twist in roving and thereby to ensure good control over drafting waves. The study has been completed.

A STUDY ON THE EFFECT OF YARN CONDITIONING ON YARN CHARACTERISTICS

The characteristics of hygroscopic textile yarns, in particular cotton yarn are very much influenced by the amount of moisture present in them. With the increasing speeds of post spinning textile operations like warping, sizing, knitting, weaving, etc., sensitiveness to snarling and spirality of hosiery yarns it has become imperative to produce and supply yarns of increased performance and consistent quality levels. As a result, with the relative advantages and benefits claimed, yarn conditioning of packages after winding has become

Table 16 Draft distribution between fly frame & ring frame and the corresponding yarn quality attributes

Ex. No.	Count	IFC in Drawframe sliver (mgf/ tex)	Draft in fly frame	Draft in spinning frame	Total draft	Yarn quality attributes				
						Single yarn strength CV (%)	Single yarn elongation CV (%)	Imperfections / km		
								Thin places (- 50 %)	Thick places (+ 50%)	Thin + Thick places
1	60s CW (ULTIMA-AKALA)	28.00	11.8	38	450	10.02	12.96	8	38	46
			10.0	45		8.69	11.76	2	16	18
2	60s CW (MCU5)	22.00	11.8	38	450	9.16	12.12	10	26	36
			10.0	45		12.24	13.75	16	36	52

an integral part of the manufacturing sequence in yarn production. In this context, SITRA has conducted a study with a view to generate relevant information in this area and to understand the real benefits of yarn conditioning process(YCP) and to specifically see whether the changes in physical characteristics of the material after conditioning is sustained over a period of time. The study has been completed.

AN INTERMILL STUDY ON THE QUALITY OF COMPACT YARNS, 26TH SURVEY

SITRA has been over the years conducting surveys on the quality of yarns in the Indian Textile Industry. As considerable numbers of mills are producing compact yarns in their product portfolio, SITRA undertook a study on the compact yarn quality to help the mills in bench-marking. Various yarn parameters will be evaluated besides the respective sliver samples for their physical characteristics. The results will also be compared with Uster Statistics. The trends in various quality characteristics in relation with the earlier survey data will also be projected. This study was started in Dec 2013 and as many as 42 mills have sent their samples for evaluation. In all, 144 yarn samples (cops & cones) and 63 fibre samples have been received and assessment of the various parameters is in progress. An interim report of the results is being sent to the individual mills.

DEVELOPMENT OF SITRA STATISTICS

The inter-mill survey on the quality of compact yarns initiated during this year is a starting point that attempts to establish standards, and will continue to be done on a larger scale for all types of yarns in future to develop “SITRA STATISTICS” exclusively for Indian Mills and create guideline values for fibre and yarn relationship characteristics. The Indian Statistical Institute (ISI) is acting as the knowledge partner and providing rational inputs for this activity.

MACHINERY DEVELOPMENT

DESIGN AND DEVELOPMENT OF A MOBILE DOFFING SYSTEM FOR RING SPINNING MACHINES

Existing semi automatic mobile doffing system has some limitations such as 20 – 30% starting end breaks, missed doffs and need to press the cops in to proper position manually.

In order to overcome the above mentioned draw backs, suitable modifications have been carried out as outlined below.

a) Yarn holding device is fitted on the spindle to hold the yarn at the time of restarting.

b) A setting gauge for the machine to achieve 100% doffing of cops is designed

c) To improve alignment /positional stability, a rail made of square pipes has been used

d) A cam driven mechanism has been designed to press the cop on the spindle. The performance of the pressing device is under evaluation

Performance evaluation of the mobile doffing system is being conducted in a local mill on a ring spinning frame. Our observations are as below.

1. Two mobile doffer units are required for one long frame. For a 25,000-spindle mill, about 6 - 10 units may be required based on the count pattern

2. Time required to complete doffing operation is about 3 minutes.

3. 4 persons are required to carry out the doffing operation in one machine.

4. After incorporating the cop pressing mechanism, further reduction of one operative is possible.

Cop Pressing mechanism needs some fine tuning to carry out the doffing operation smoothly.

While conducting the performance trial during doffing, it is noted that perfect alignment is essential for 100% doffing. After mounting the mobile doffer in different machines, it is noticed that lappet hook, separator plate and ABC rings are causing hindrance to the rotation bobbin doffing discs.

At present, this unit is suitably modified to suit most widely used models of ring frame.

OPERATIONAL STUDIES

COSTS, OPERATIONAL PERFORMANCE AND YARN QUALITY: INTER-MILL STUDY OF KEY FACTORS – 29TH STUDY

The inter-mill study of key factors was initiated by SITRA 17 years ago (1997). So far 29 studies have been completed. Response for the 29th CPQ study was good with a participation of 123 mills. Performance of the mills which had participated in 28th (for April to June 2012) and 29th (for April to June 2013) CPQ studies, is given in Table 17.

During the 2nd quarter of 2013, mills on the whole had performed well by recording a huge increase in the contribution (by 26%) as compared to the corresponding quarter of 2012 (Table 17), which was mainly due to the substantial increase in the yarn sale value (by 18%). The increase in the sale value was contributed by the three parameters viz. increase in yarn selling price (by 35%), increase in ring frame machine productivity (by 37%) and coarser average count (by 28%).

Raw material cost, a major component in the yarn cost, however, showed a substantial increase of 17% during this period. The other two cost components viz. power cost and salaries and wages cost also registered an increase of 10% and 15% respectively. Nevertheless, the huge increase in the yarn sale value more than off-set the increase registered by these three cost components and thus helped the mills to realise significant increases in the contribution. While the production rate remained the same at 99 g per spindle shift (adjusted to 40s count), the spindle utilisation registered an increase of about 6%.

Further analysis shows that out of the 94 common mills, three-fourths (71 mills) had registered an increase of Rs 1900 per spindle per year in the contribution, ranging from Rs 50 to Rs 9370 between mills (Figure 4). The remaining mills (23 mills) recorded a drop of Rs 850 per spindle per year in the contribution, ranging from Rs 20 to Rs 5650 between mills. It is interesting to observe that none of these 23 mills had earned a negative contribution. In fact, the average contribution

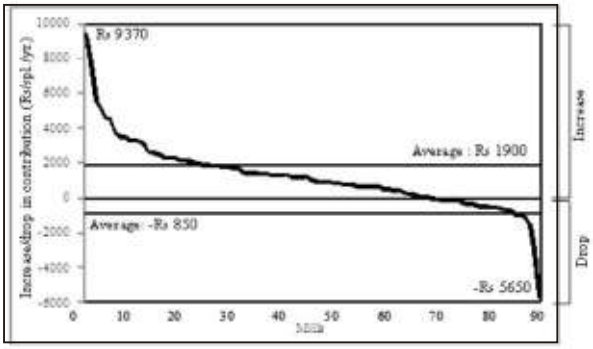


Figure 4 Differences in the contribution between the two studies (Q2 of 2012 and 2013)

Table 17 Comparison of costs and operational parameters between the two studies

Parameters		Common mills' (94) avg.	
		28th study (Apr.- June 2012)	29th study (Apr.- June 2013)
Contribution	- Rs/spindle/year	4620	5840
Salaries and wages cost	- Rs/spindle/year	1570	1810
Power cost	- Rs/spindle/year	3000	3300
Raw material cost	- Rs/kg of yarn	126	133
	- Rs/spindle/year	12820	15050
Yarn selling price	- Rs/kg	235	248
Yarn sale value	- Rs/spindle/year	22010	26000
Prodn./spl./8 hrs.(adj.to 40s) in g		99	99
Spindle utilisation (%)		87	92
HOK - up to ring frames (adj.to 40s)		18	17
Average count		48s	46s

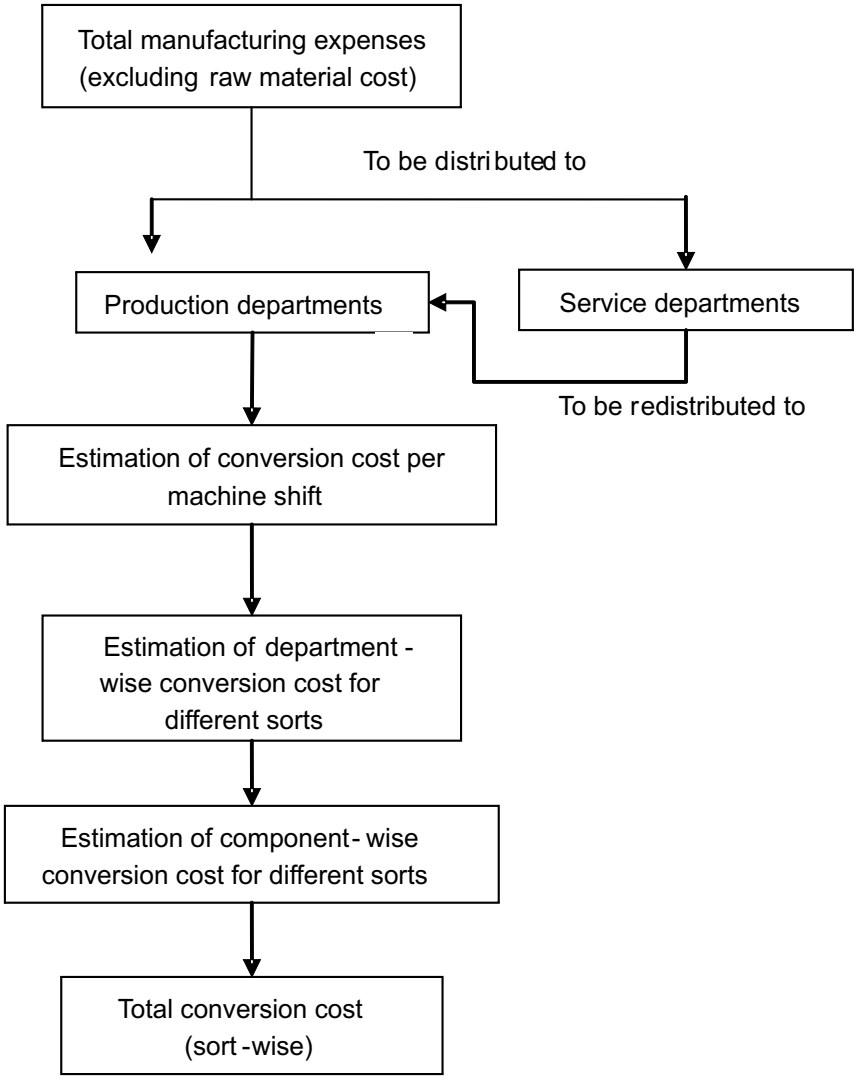
recorded by these mills during Q2 2013 was fairly high at Rs 4460 per spindle per year. The main reason for the drop in the contribution in these mills was the increase in all the three major input costs viz., raw material cost, salaries and wages cost and power cost (by Rs 2040 per spindle per year) which more than off-set the increases in the yarn sale value (by Rs 1190 per spindle per year). On the other hand, the substantial increase in the contribution earned by the 71 mills was largely due to the increase in the sale value (by Rs 4900 per spindle per year) which more than off-set the increases in all the three major input counts (by Rs 3000 per spindle per year).

A STUDY ON GREY WOVEN FABRIC CONVERSION COST

Estimation of sort-wise yarn to grey woven fabric conversion cost is highly essential to optimise product-mix so as to maximise the profit margin. But, with regard to the correct procedure for estimating fabric conversion cost, no literature is available as on date. Hence, SITRA had conducted a study last year with a view to suggest a suitable method for arriving at the grey woven fabric conversion cost.

The study was completed and a research report on 'How to estimate sort-wise yarn to grey woven fabric conversion cost correctly? – SITRA method' was brought out. The salient findings of the study are given below.

An elaborate procedure to estimate sort-wise and component-wise yarn to grey fabric conversion cost has been suggested which is summarised below:



Description	Basis of allocation
Salaries and wages cost	
Wages	Department-wise man-days engaged
Salaries	Department-wise staff engaged
Power cost	
EB/purchased power	Department-wise units consumed
Fuels like Diesel, HFO etc., and other oils	User departments
Boiler fuel & other expenses	User departments
Humidification	User departments' area
Stores cost*	
Consumable stores	Department-wise consumption
Factory overheads	
Rent, rates and taxes	Departments' area
Insurance	Machinery value
Security charges	Department-wise man-days engaged
Canteen welfare expenses	Department-wise man-days engaged
Workshop	Services rendered to the departments
Administrative overheads	
Repairs & maintenance of machinery, building and equipment	Department-wise actual expenses
General expenses (printing & stationery, travelling expenses, audit fees, bank charges, etc.)	Department-wise cost of production
Interest	
Interest - Term loan	Department-wise machinery value/ depreciation value
-Working capital	Department-wise cost of production
Depreciation	
Machines	Department-wise depreciation value
Buildings	Department-wise floor area

'*' *Excluding sizing materials cost and packing materials cost*

For validating the SITRA method, studies were conducted in 4 weaving units and the methods followed by them were compared.

Mill no. 1

The method followed by the Mill was almost similar to that suggested by SITRA. However, it did not consider the actual efficiency and production rates in the preparatory departments. Moreover, the loom utilisation assumed by the Mill in shuttle weaving was very much higher than the actual. This had resulted in under estimation of the fabric conversion cost by about 45%.

Mill no. 2

The Mill had been treating the sizing unit (warping and sizing departments) and loom shed (weaving and grey warehouse departments) as separate cost centres. It was mainly estimating the monthly expected profit for each cost centre based on the actual expenses and prevailing market rates for conversion charges.

Based on the monthly P&L, it altered the expected pick conversion rate (overall). But, it did not estimate sort-wise conversion cost. Since conversion cost varies between sorts significantly, it was suggested that using SITRA method, the Mill should estimate sort-wise fabric conversion cost once in 3 months or whenever the sorts are changed.

Mill no. 3

The method followed by the Mill in the estimation of sort-wise fabric conversion cost was satisfactory. The overall pick conversion rate estimated by the Mill was comparable with that estimated by using SITRA method.

Mill no. 4

There was only a marginal difference in the overall conversion cost, in terms of pick conversion rate (for each type of loom), between the Mill method and SITRA method. However, the pick conversion rate between sorts varied by more than 60% in projectile, 13% in rapier and 10% in jacquard looms.

A STUDY ON LUBRICATION PRACTICES IN RING FRAMEs

The study was initiated last year. As many as 87 mills, spread all over the country, had participated by sending the relevant information on lubrication of ring frames through a questionnaire. Lubrication practices of four models of ring frames from two different makes (LMW- LR 6, G 5/1 and LR 60 and KTTM RXI 240) were analysed. The study was completed. An inter-mill study report “A study on lubrication practices in ring frames” was brought-out. The following are the major findings of the study.

Expected consumption of lubricants

Quantity of lubricants per spindle per year

Expected consumption of grease, estimated from the mills' data, in the above 4 models of ring frames averaged at 11.4 g per spindle per year whereas that of spindle oil and other oils averaged at 8.7 ml and 18.7 ml per spindle per year respectively (Table18). This would mean that in a 30000 spindle mill having the above 4 models of ring frames, the total consumption of lubricants per year in the ring frame shed, on the average, would be 340 kg of grease, 260 litres of spindle oil and 560 litres of other oils.

Table 18 Expected quantity of lubricants per spindle per year

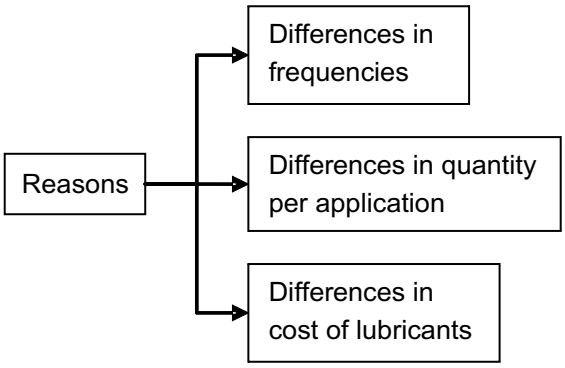
Ring frame model	Grease (g)				Spindle oil (ml)				Other oils (ml)			
	Min.	Max.	Avg.	Diff. between mills (%)	Min.	Max.	Avg.	Diff. between mills (%)	Min.	Max.	Avg.	Diff. between mills (%)
LR 6/S	3.9	30.7	11.8	687	2.5	21.0	8.7	740	5.4	54.6	20.9	911
G 5/1	3.9	24.6	12.4	531	2.5	14.4	7.9	476	4.8	45.0	18.4	838
LR 60	4.4	17.8	10.4	305	5.0	15.0	9.3	200	2.8	43.4	15.3	1450
RXI 240	3.9	21.1	11.1	441	4.0	12.0	9.0	200	7.5	36.5	20.1	387
Overall	-	-	11.4	491	-	-	8.7	404	-	-	18.7	897

Differences in the expected consumption of the lubricants between mills in all the 4 models were mindboggling at 4 to 8 times in grease, 3 to 8 times in spindle oil and 5 to 16 times in other oils.

Cost of lubricants per spindle per year

The total expected cost of lubricants per spindle per year amounted to about Rs 9, ranging from Rs 8.3 to Rs 9.3 between models (Table 19). Of the total cost of lubricants, grease accounted for about 50% followed by other oils (34%) and spindle oil (17%).

In terms of per frame (1200 spindles) per year, the average cost of lubricants worked out to around Rs 11000 which means that a 30000 spindle mill having the above models of ring frames would spend, on the average, about Rs 2.6 lakhs per year towards lubricating the ring frames. The differences in the cost of lubricants between mills were also very high in all the 4 models; 5 to 17 times in grease, 3 to 6 times in spindle oil and 7 to 28 times in other oils.



Reasons for the high inter-mill differences in the consumption of lubricants

Grease

* Number of locations where greasing is being done, range from 8 to 10 in the various models. Of the different locations, three locations viz. top rollers, bottom rollers and spindle tape tension pulleys had accounted for about 75% of the total consumption of grease in terms of quantity and 85% in terms of cost.

Spindle oil

* Mills were using different models of bolsters such as HD, VN, HN, HF1, CSI and HPS from various manufacturers like SKF, Texparts, Novibra, Nihon, etc. Quantity of spindle oil to be filled-in per occasion varies widely between the types/makes of bolsters. Hence, this may be one of the reasons for the wide inter-mill differences in the expected consumption of spindle oil in all the 4 models of ring frames.

* Quantity per application ranged widely from as low as 2.5 ml to a high of 9 ml between mills and models. Frequency of application varied from once in 4 months to once in 12 months. Inter- mill difference in unit cost of spindle oil was high at 5 times.

Table 19 Expected cost of lubricants per spindle per year

(Amount in Rs)

Ring frame model	Grease				Spindle oil				Other oils				Total cost/ spindle /year
	Min.	Max.	Avg.	Diff. between mills (%)	Min.	Max.	Avg.	Diff. between mills (%)	Min.	Max.	Avg.	Diff. between mills (%)	
LR 6/S	0.8	13.8	4.4	1625	0.7	4.0	1.6	471	0.7	10.5	3.3	1400	9.3
G 5/1	0.8	13.1	4.1	1538	0.7	4.0	1.5	471	0.8	6.3	2.7	688	8.3
LR 60	1.8	12.1	4.9	572	0.7	2.7	1.6	286	0.3	8.5	2.6	2733	9.1
RXI 240	1.9	9.0	3.7	374	0.6	1.9	1.3	217	0.8	5.9	3.3	638	8.3
Overall	-	-	4.3	1027	-	-	1.5	361	-	-	3.0	1365	8.8

Other oils

* Number of other oils application locations vary between models: LR 6/S and G 5/1 = 8 locations; LR 60 = 4 locations and RXI 240 = 3 locations.

* In the LMW make ring frames, 3 locations viz., duo-flex oil topping/ additional drive oil changing, central lubricating pump oil topping and delay draft gear box oil changing had accounted for 70% (G 5/1) to 95% (LR 60) of the total consumption of other oils. In the case of RXI 240 frames, twisting and drafting gear box oil changing and lifting gear box oil changing, put together, accounted for almost the entire consumption of other oils.

Types of lubricants used by the mills

* Mills were using nearly 35 types of grease, manufactured by around 15 different companies. As many as 8 types of oils from 7 manufacturers were being used by mills for lubricating spindle bolsters. For application of oils in other locations, mills were using around 20 types of oils from 6 manufacturers.

Suggestions for improving the lubrication practices in ring frames

(I) Revisit the existing lubrication practices and optimise the consumption of lubricants both in terms of quantity and cost, without compromising yarn quality, ring frame machine productivity and consumption of spares. The information covered in this report, no doubt, would be helpful to mills in this regard. While optimising the lubrication practices, mills may take into account the practices suggested by the respective machinery manufacturers, as a guideline.

(ii) Periodically check the quantity of output per stroke from grease guns and condition of spindle oil lubricator and ensure their proper functioning.

(iii) Ensure that quantity of spindle oil being applied per occasion matches with that recommended by the bolster manufacturers and check oil level in all the bolsters using an appropriate dip-stick.

(iv) Use appropriate type grease guns, so as to avoid wastage of grease.

(v) Display the lubrication particulars such as schedules, frequencies, quantity per application, type of lubricants, etc. at prominent locations, preferably in the maintenance room and respective departments and periodically update changes, if any.

(vi) Sensitise fitters and other maintenance personnel, responsible for the lubrication activities about the importance of applying correct quantity per application, using right type of lubricants and following appropriate frequency of lubrication.

(vii) Store the lubricants in suitable containers (having lids) with proper identification marks so as to avoid contamination and mix-up.

(viii) Periodically study the lubrication practices being followed in various machines and if need be, revise the frequencies and quantity per application.

(ix) Maintain suitable records for lubrication activities which would in turn be helpful in monitoring adherence of frequencies and application of lubricants.

INTER-MILL STUDY ON FIBRE TO YARN CONVERSION COST - 3RD STUDY

The study was conducted based on the conversion cost particulars that were collected from mills in the 29th CPQ study, covering data for the 2nd quarter of 2013 (April-June). It covers conversion cost particulars of as many as 157 different counts and varieties of yarns. A detailed analysis was made for 11 different counts for which 5 and above mills had furnished the data. The study was completed and an inter-mill study report was brought-out.

Overall conversion cost in 2013

Average conversion cost, in terms of per kilogram of yarn, was found to increase steeply as the count became finer i.e. from as low as about Rs 63 in 30s count to a high of about Rs 185 in 80s count (Table 20).

Table 20 Count-wise conversion cost

Period: April-June 2013

S. no.	Count	Conversion cost/kg of yarn (Rs)				Conv. cost/ kg/ count (Rs)	Conv. cost/ spl./ shift (Rs)	No. of mills
		Average	Minimum	Maximum	% difference			
1.	30s KH-Ex.	64.2	48.4	91.2	88	2.14	11.3	5
2.	30s CH-Ex.	62.4	52.9	75.8	43	2.08	12.1	11
3.	32s KH-Ex.	69.2	55.1	91.9	67	2.16	11.0	6
4.	40s K	87.7	71.4	104.1	46	2.19	10.0	6
5.	40s C	77.0	62.8	90.2	44	1.93	9.0	7
6.	40s C-Comp.	74.0	55.0	92.7	69	1.85	9.5	7
7.	40s CH-Ex.	80.5	75.2	88.1	17	2.01	10.3	6
8.	50s CH-Ex.	104.9	85.6	121.8	42	2.10	9.6	6
9.	60s C	132.0	91.8	196.3	114	2.20	8.1	10
10.	60s C-Comp.	131.8	113.4	160.1	41	2.20	9.0	6
11.	80s C	183.7	167.7	204.1	22	2.30	7.3	5

Between mills, the conversion cost differed considerably in all the counts, ranging from about 20% to over 100%, the overall difference being high at 55%. Such a huge difference in the conversion cost between mills is mainly due to variation in operational parameters like production rate, labour productivity, capacity utilisation, energy consumption etc., and cost parameters such as wage rate, staff salary, power cost per unit, stores and packing materials cost, interest commitment and investment on plant & machinery.

In terms of per kilogram per count, the conversion cost did not show any clear trend between counts. The conversion cost averaged at Rs 2.10 per kg per count, varying from Rs 1.85 to Rs 2.30 between counts. However, in terms of per spindle shift, it showed a declining trend as the count became finer i.e. in 30s CH-Ex., it was around Rs 12 whereas in 80s C, it was only about Rs 7.

Item-wise conversion cost

Item-wise conversion cost also showed an increasing trend as the count became finer (Table 21). For example, the salaries and wages cost in 30s count averaged at about Rs 9.5 per kg of yarn whereas in the superfine count (80s C), it was more than 3 times high at Rs 34 per kg of yarn. The power cost which was around Rs 25 per kg of yarn in 30s count was almost 3 times high at about Rs 75 per kg of yarn in 80s C.

Table 21 Item-wise conversion cost per kg of yarn

(Amount: Rs/kg of yarn)

S. no.	Count	YSP (a)	RMC (b)	Conversion cost							Net profit (a-b-c)
				SWC	Power	Stores & packing	Admn. OH	Int.	Dep.	Total (c)	
1.	30s KH-Ex.	189.8	123.8	9.4	24.5	6.0	4.8	12.2	7.3	64.2	1.8
2.	30s CH-Ex.	204.8	131.8	9.5	23.4	7.0	5.5	9.6	7.4	62.4	10.6
3.	32s KH-Ex.	188.4	123.0	9.5	27.2	6.0	4.7	12.9	8.9	69.2	(-) 3.8
4.	40s K	206.8	120.9	12.8	34.4	7.3	10.0	13.7	9.5	87.7	(-) 1.8
5.	40s C	234.1	139.8	13.5	35.6	6.3	4.7	8.9	8.0	77.0	17.3
6.	40s C-Comp.	242.0	138.1	12.3	32.0	7.7	7.6	7.3	7.1	74.0	29.9
7.	40s CH-Ex.	226.5	132.8	12.9	31.1	8.8	7.0	11.7	9.0	80.5	13.2
8.	50s CH-Ex.	254.7	143.8	14.9	40.4	10.0	8.3	17.6	13.7	104.9	6.0
9.	60s C	282.9	143.1	27.3	54.3	10.1	11.0	18.3	11.0	132.0	7.8
10.	60s C-Comp.	305.4	142.1	23.0	55.0	12.3	7.6	19.9	14.0	131.8	31.5
11.	80s C	351.7	161.5	33.9	73.5	16.3	13.0	30.0	17.0	183.7	6.5

Changes in the conversion cost between 2010 and 2013

A comparison of conversion cost between 2010 and 2013 has been made. Table 22 shows the year-wise conversion cost for 7 different counts.

Table 22 Changes in the conversion cost between 2010 and 2013

Count	Conversion cost (Rs/kg of yarn)		% increase in the conversion cost in 2013 over 2010
	2010	2013	
30s CH -Ex.	45.4	62.4	37
40s K	63.8	87.7	37
40s C	65.1	77.0	18
40s CH -Ex.	66.9	80.5	20
60s C	92.3	132.0	43
60s C -Comp.	93.0	131.8	42
80s C	138.5	183.7	33

The above table shows a remarkable increase in the conversion cost (by about 33%) between 2010 and 2013, ranging from about 20% to 45% increase in different counts.

Contribution of item-wise conversion cost on the overall increase in the conversion cost in 2013

An analysis of the item-wise conversion cost shows that except depreciation cost, all the 5 cost components had witnessed an increase during this period (Figure 5). The increase in the power cost accounted for about 50% of the overall increase in the conversion cost, followed by the increase in the interest cost (16%). The other three cost components viz. salaries & wages cost, administrative overheads and stores and packing materials cost had contributed almost in equal proportions for the remaining increase.

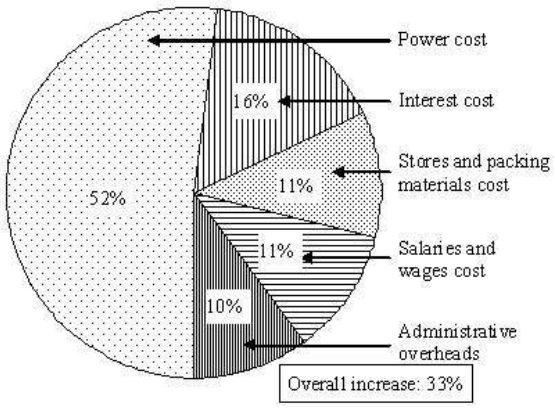


Figure 5 Contribution of item-wise cost on the overall increase in the conversion cost in 2013

Power cost per unit during this period had registered a jump of about 40% (from Rs 4.74 per unit in 2010 to Rs 6.65 per unit in 2013, as per the 25th and 29th CPQ studies). The interest rate which was prevailing at 12% in 2010 moved to a level of 14% to 15% in 2013. The salaries and wages cost had also witnessed an increase of about 15% during this period.

Impact of increase in the conversion cost on profit margin

Average net output value, conversion cost and profit margin that prevailed in the above 7 counts in 2010 and 2013, are shown in Table 23.

Table 23 Net output value, conversion cost and profit margin

Amount: Rs/kg of yarn

Count	Net output value		Increase in the NOV in 2013 over 2010 (%)	Conversion cost		Increase in the conv. cost in 2013 over 2010 (%)	Net profit/ loss		Drop in the net profit in 2013 over 2010 (%)
	2010	2013		2010	2013		2010	2013	
30s CH-Ex.	62.7	73.0	16	45.4	62.4	37	17.3	10.6	39
40s K	75.2	85.9	14	63.8	87.7	37	11.4	(-) 1.8	116
40s C	85.2	94.3	11	65.1	77.0	18	20.1	17.3	14
40s CH-Ex.	73.6	93.7	27	66.9	80.5	20	6.7	13.2	(-) 97
60s C	119.4	139.8	17	92.3	132.0	43	27.1	7.8	71
60s C-Comp.	135.6	163.3	20	93.0	131.8	42	42.6	31.5	26
80s C	165.5	190.2	15	138.5	183.7	33	27.0	6.5	76
Average	-	-	17	-	-	33	-	-	35

On the whole, profit margin of all the above 7 counts had registered a drop of 35% in 2013, ranging from a drop of 116% in 40s K to a gain of about 100% in 40s CH-Ex. counts. Though the conversion cost of all the 7 counts had recorded an increase of 33%, nevertheless, during this period, the NOV had registered a significant increase of 17%. But for the increase in the NOV, the drop in the profit margin in 2013 would have been very high, with some more counts incurring loss.

COMPACT YARN MANUFACTURING – A VALUE ADDITION

Spinning mills, towards improving their profitability, have been exploring both domestic and overseas markets to manufacture value added yarns. One of the value added yarns which is gaining importance in recent years, is compact yarn. Though the compact yarn spinning system was introduced in the industry almost 2 decades ago, in India its penetration has gained momentum only during the last few years.

Using the data available in the 29th CPQ study, an analysis was made on the differences in yarn selling price (YSP), raw material cost (RMC), NOV (net output value), yarn quality and ring frame production rate between combed compact yarns (40s C, 60s C and 80s C) and the corresponding normal combed yarns (non-compact yarns). Changes noticed in the techno-commercial parameters of 40s C-Comp., 60s C-Comp. and 80s C-Comp. yarns during the last 5 years (2009-13) have also been analysed. The study was completed and a research report was brought-out.

Comparison of techno-commercial parameters of compact yarns and corresponding normal yarns

Average values of various techno-commercial parameters furnished by the mills in the 29th CPQ study, pertaining to 3 selected compact yarns (40s C-Comp., 60s C-Comp. and 80s C-Comp.) and corresponding normal combed yarns are summarised in Tables 24 to 28.

Table 24 Average YSP, RMC and NOV for normal and compact yarns

Period: April-June 2013

Count	Normal yarn				Compact yarn			
	YSP (Rs/kg)	RMC (Rs/kg of yarn)	NOV		YSP (Rs/kg)	RMC (Rs/kg of yarn)	NOV	
			Rs/kg of yarn	Rs/spl./ shift			Rs/kg of yarn	Rs/spl./ shift
40s C	234	139	95	11.2	246	142	104	13.0
60s C	287	144	143	8.9	321	150	171	11.6
80s C	352	155	197	7.6	402	169	233	10.1

Table 25 Average ring frame productivity parameters

Period: April-June 2013

Count	Normal yarn				Compact yarn			
	Spindle speed (rpm)	Tpi	Prodn./ spl./ shift (g)	End breaks/ 100 spindle hours	Spindle speed (rpm)	Tpi	Prodn./ spl./ shift (g)	End breaks/ 100 spindle hours
40s C	18930	26.6	118	4.6	19180	25.7	124	4.5
60s C	18490	33.0	62	6.6	19980	32.3	68	5.1
80s C	17950	38.0	39	8.6	18910	36.4	43	6.0

Table 26 Average yarn realisation and comber noil

Period: April-June 2013

Count	Yarn realisation (%)		Comber noil (%)	
	Normal yarn	Compact yarn	Normal yarn	Compact yarn
40s C	69.8	69.5	17	17
60s C	68.4	67.7	17	18
80s C	68.7	67.6	18	17

Table 27 Average cotton quality

Period: April-June 2013

Count	Normal yarn					Compact yarn				
	2.5% SL (mm)	UR (%)	Strength (g/tex)	Fine - ness (µg/ inch)	Trash (%)	2.5% SL (mm)	UR %	Strength (g/tex)	Fine - ness (µg/ inch)	Trash (%)
40s C	30.1	47.0	23.0	3.9	3.0	30.3	47.0	22.2	3.8	3.1
60s C	30.9	46.8	23.8	3.8	3.1	31.5	46.9	24.7	3.8	3.0
80s C	32.7	46.6	25.1	3.6	2.7	34.0	47.5	25.3	3.5	2.8

Table 28 Average yarn quality

Period: April-June 2013

Count	Normal yarn				Compact yarn			
	CSP	U%	Total imper - fections /km	Hairi - ness index	CSP	U%	Total imper - fections /km	Hairi - ness index
40s C	2750	10.5	164	5.4	3100	10.0	90	3.8
60s C	2650	11.7	353	4.4	3200	10.9	175	3.1
80s C	2600	12.6	686	4.1	3150	11.5	267	2.7

A detailed analysis of the data furnished in Tables 8 to 12 reveals the following:

- Participant mills had realised a higher selling price for the compact yarns as compared to the corresponding normal yarns, the difference ranged from Rs 12 per kg in 40s to Rs 50 per kg in 80s counts.
- Raw material cost (clean material cost) was higher by 2% (40s C-Comp.) to 9% (80s C-Comp.).
- In spite of the higher RMC, higher selling price had helped the mills to realise 10% to 20% higher NOV (in terms of per kg of yarn) in the compact yarns.
- The NOV in terms of per spindle shift was about Rs 2 to Rs 2.5 more than the corresponding non-compact yarns i.e. Rs 1800 (40s C-Comp.) to Rs 2700 (60s C-Comp.) more NOV per spindle per year. In other words, a 30000 spindle mill manufacturing 60s C-Comp. yarn would have realised over Rs 800 lakhs more NOV per year when compared to a mill producing corresponding non-compact yarn.
- Ring frame production rate was substantially higher by 10% in 60s C-Comp. and 80s C-Comp. yarns followed by 40s C-Comp. yarn (by 5%).
- In 60s C-Comp. yarn, higher spindle speed had contributed to about 80% of the increase in production rate while lower tpi accounted for the remaining 20%. In the case of 80s C-Comp. yarn, however, both higher spindle speed and lower tpi had contributed equally for the increase in the production rate. In 40s C-Comp. yarn, the higher production rate was largely (by 70%) due to the lower tpi and partly (by 30%) because of higher spindle speed.
- It is interesting to observe that the average yarn realisation (%) as well as comber noil extraction (%) was, by and large, at the similar levels for both normal and compact yarns.
- In both 40s and 60s counts, there was not much difference in the overall quality of cotton used by the mills for compact yarns and corresponding normal yarns. However, for the super fine count (80s C-Comp.), mills used marginally better quality cotton, particularly 1.3 mm more 2.5% span length. This may be one of the reasons for the relatively higher raw material cost noticed in 80s C-Comp. yarn.
- Yarn CSP was 300 to 500 units higher in compact yarns.
- Compact yarns were relatively more even with 50% to 60% lower total imperfections than the corresponding normal yarns.
- Hairiness which is one of the important quality characteristics associated with compact yarn, was about 30% lower in compact yarns

Changes in the techno-commercial parameters of compact yarns during the last 5 years (2009-13)

Using the data available in the CPQ studies, a detailed analysis was made on the changes in the techno-commercial parameters of 40s, 60s and 80s combed compact yarns during the last 5 years (2008-13); results of which are discussed below.

(I) Net output value

During the last 5 years, the NOV, in terms of per kg and per spindle shift, had registered a two-fold increase in the case of 40s C-Comp. and 60s C-Comp. yarns whereas 80s C- Comp. yarn had recorded a 60% increase.

(ii) Yarn quality

Parameter	40s C -Comp.	60s C -Comp.	80s C -Comp.
CSP	No significant change	8% increase	3% increase
U%	No significant change	No significant change	No significant change
Total imperfections/ km	20% reduction	No significant change	No significant change

(iii) Yarn realisation and ring frame production rate

During the last 5 year period, yarn realisation had remained unchanged in all the 3 counts (40s: 70%, 60s: 68% and 80s: 68%). In the case of production rate, 40s C-Comp. yarn registered a 4% increase whereas in 60s C-Comp. and 80s C-Comp. yarns, the production rate did not show any change (60s - about 68 g and 80s - about 43 g).

IMPACT OF INTER-MILL VARIATION IN THE TECHNO-COMMERCIAL PARAMETERS ON THE FINANCIAL PERFORMANCE OF SPINNING MILLS

It is well known that there exists a wide difference between mills in various technical and commercial parameters like labour and machine productivity, yarn realisation, yarn quality, yarn selling price, raw material cost, etc, in view of the differences in the technology of machines, technical expertise, raw material quality, marketing strategy, purchase policy, etc.

Using the data furnished by the mills in the online surveys, an analysis was made to find out the inter-mill variation in the following techno-commercial parameters and their impact on the financial performance of the mills. As many as 8 different counts and varieties of yarns have been considered for the analysis (40s K, 40s C, 60s C, 80s C, 40s C-Comp., 50s C-Comp., 60s C-Comp. and 80s C-Comp.).

Techno-commercial parameters considered for the analysis

a) YSP – ex-mill yarn selling price (Rs/kg)

b) Raw cotton cost (Rs/kg)

c) RMC – clean cotton cost (Rs/kg of yarn)

d) NOV – net output value (YSP-RMC) [in terms of Rs/kg of yarn and Rs/spindle/shift]

e) Net revenue – NOV in Rs/spindle/year i.e. before providing for conversion cost

f) YR – yarn realisation (%) and

g) PR – production/ spindle/ shift of 8 hours in ring frames (g)

Inter-mill variation in techno-commercial parameters between counts in September 2013

Table 29 and Figure 6 show the inter-mill variation (mean deviation %) in the various techno-commercial parameters in the 8 different counts in September 2013 (6th online survey).

Table 29 Inter-mill variation (mean deviation %) in the various techno-commercial parameters in September 2013

Count	Mean deviation (%)						
	YSP	Raw cotton cost	RMC	NOV		YR	PR
				per kg of yarn	per spindle shift		
40s K	3.8	5.8	5.2	14.8	24.1	1.5	14.5
40s C	2.7	3.4	4.2	9.6	13.9	3.6	6.8
60s C	3.0	7.1	8.0	12.6	18.3	2.4	10.7
80s C	3.8	7.5	8.7	5.5	7.5	1.3	6.5
40s C-Comp.	2.2	7.3	7.6	13.0	15.6	2.9	5.8
50s C-Comp.	2.9	9.6	11.1	12.0	17.8	2.7	7.2
60s C-Comp.	3.9	9.6	9.7	8.6	13.7	2.3	9.0
80s C-Comp.	4.8	5.5	7.0	9.7	16.5	1.6	8.9
Average	3.4	7.0	7.7	10.7	15.9	2.3	8.7

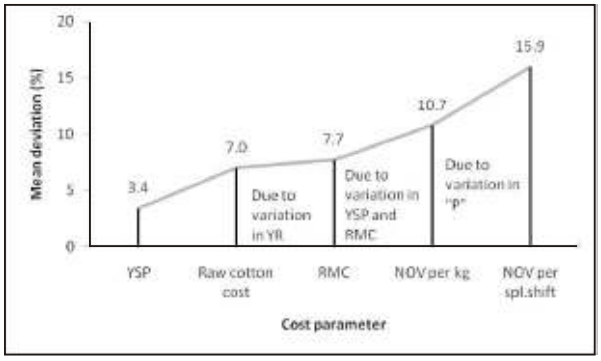


Figure 6 Overall variations (mean deviation %) in the techno-commercial parameters (September 2013)

Yarn selling price

Inter-mill variation in the YSP for different counts ranged from 2% to 5%, the average being about 3%. Factors influencing the ex-mill price of a yarn, in a given period, include the marketing strategy of mills like type of sales (cash or credit or distress sales), customer relationship, actual count maintained, etc., and yarn quality.

Raw cotton cost

The other commercial parameter, namely raw cotton cost, showed an overall variation of 7% between mills with the variation in different counts ranging from 3% to 10%. Factors responsible for the differences in the raw cotton cost between mills include purchase policy of mills (like cash or credit purchase), proximity to cotton growing areas, transportation costs, availability of working capital, period of purchase, etc.

Raw material cost

The clean cotton cost (RMC), however, showed a 10% higher inter-mill variation (avg. mean deviation: 7.7%) than the variation prevailed in the raw cotton cost (avg. mean deviation: 7%) which was largely due to the variation in yarn realisation and partly because of the differences in the sales realisation from wastes between mills. Yarn realisation during this period showed an inter-mill variation of about 2%.

Net output value (NOV)

The NOV per kg of yarn is one of the most important factors that determine the profitability of a spinning mill; since the NOV, less conversion cost gives net profit. It had registered a high inter-mill variation of about 11% with the variation ranging from 6% to 15% in different counts, which in turn was because of the inter-mill variation noticed in both YSP and RMC. Of the total variation in the NOV per kg, one-third was due to the differences in the YSP and the remaining two-thirds are because of the variations in the RMC between mills.

The NOV per spindle per shift which takes into account both the NOV per kg and ring frame production rate, recorded a very high inter-mill variation of 16% i.e. 50% more than that noticed in

the NOV per kg, which was entirely due to the differences in the production per spindle between mills. The production per spindle registered about 9% variation between mills.

Inter-mill variation in techno-commercial parameters between months (April-September 2013)

Data furnished by the mills in the first 6 online surveys (April-September 2013 data) for the same 8 counts viz. 40s K, 40s C, 60s C, 80s C, 40s C-Comp., 50s C-Comp., 60s C-Comp. and 80s C-Comp. have been analysed to find out the inter-mill variation in the various techno-commercial parameters between months (Table 30).

During the 6 months period, the inter-mill variation in the YSP between months was almost stable at around 3%. However, the inter-mill variation in the raw cotton cost showed a disturbing trend with the mean deviation increasing from 4.5% in April to 7% in September. This would have made a significant impact on the inter-mill variation in NOV which in turn would have widened the gap in profit margins between mills substantially.

The inter-mill variation in NOV per kg of yarn as well as NOV per spindle shift registered an increase of about 25% during this period. It is interesting to note that the inter-mill variation in the two technical parameters (yarn realisation and production per spindle) did not show any significant trend during the 6 months period. In other words, the inter-mill variation in these two parameters was almost stable at around 2% and 9% respectively.

The above analysis clearly shows the impact of the two important technical parameters viz. yarn realisation and ring frame production rate on the financial performance between mills. For example, even if two different mills maintain the same NOV per kg of yarn, the mill which achieves a relatively higher production rate will earn more net revenue than the other mill. Also, with a relatively low NOV per kg, a mill can earn more net revenue than a mill having higher NOV per kg, provided the former maintains a higher production rate in the ring frames than the latter.

A paper on "Impact of inter-mill variation in the techno-commercial parameters on the financial performance of spinning mills" will be presented in the 55th Joint Technological Conference to be held at NITRA in May 2014.

ONLINE SURVEY OF YARN SELLING PRICE AND RAW MATERIAL COST

SITRA had initiated this unique online monthly inter-mill study of RMC and YSP last year. During 2013-14, 11 studies were completed. As many as 100 mills, from different parts of the country, had

Table 30 Inter-mill variation (mean deviation %) in various techno-commercial parameters during April to September 2013

Month (2013)	YSP	Raw cotton cost	RMC	NOV		YR	PR
				per kg of yarn	per spindle shift		
April	3.2	4.5	5.1	8.5	12.9	2.1	9.0
May	3.3	5.0	6.3	9.9	15.0	2.3	8.7
June	4.2	5.1	5.8	10.1	14.2	2.2	8.1
July	3.2	5.9	6.9	9.1	15.0	2.2	9.3
August	3.2	6.0	6.7	10.0	16.1	1.8	9.5
September	3.4	7.0	7.7	10.7	15.9	2.3	8.7
Average	3.4	5.6	6.4	9.7	14.9	2.2	8.9

Note: Figures shown in the above table indicate the average of inter-mill variation noticed in each parameter in all the 8 counts.

participated in the study conducted every month. The studies covered RMC, YSP, yarn quality, yarn realisation and ring frame production rate data of around 280 different counts and varieties of yarns with counts ranging from 4s to 120s, predominantly cotton counts. On 21st of every month, the respective survey reports, each numbering around 80 pages, were uploaded in the web portal "rmcysp.sitraonline.org".

The speciality of this online survey is the built-in database supported queries in the web portal, using which a participant mill can access the count-wise data quickly without going through the voluminous survey report. Besides the above, trends in the movement of average YSP, RMC and NOV between months were also uploaded every month.

Using the voluminous data on RMC, YSP, yarn realisation and production rate provided by the participant mills in the online surveys, the following materials were prepared and included in the survey reports.

- Compact yarn manufacturing and value addition.
- Inter-mill variations in the techno-commercial parameters and their impact on the financial performance of the mills.
- Odd counts and popular counts - an analysis.
- How can a mill analyse its technical and commercial performance periodically?
- Compact yarn vs normal yarn – a review
- How can a mill monitor its commercial performance periodically? – A case study.

Since these survey reports are being made available only to the participants, that too online, for the benefit of non-participating mills, some information covered in the online reports, as given below, have been brought-out as SITRA Focus and also published in leading textile journals.

1. Impact of inter-mill variations in the techno-commercial parameters on the financial performances of the spinning mills.

2. How can a spinning mill monitor its commercial performance periodically?

3. How can a mill analyse its technical and commercial performance periodically?

ENERGY CONSERVATION

ENERGY CONSERVATION STUDY IN AIR COMPRESSORS USING HIGH TECH INSTRUMENTS

Air compressors account for about 6% of total power consumption in spinning mills. Today, a modern spinning mill having 50,000 spindles consumes about 2 lakh units of electricity per month for air compressors alone. Recently, high technology instruments are introduced to analyze the energy efficiency of air compressors and air leakage in the distribution system. SITRA has acquired online portable compressed air flow analyzer and digital air leakage meter to conduct conservation studies in air compressors. In general, very limited attention has been paid by the technical personnel in the operation, maintenance and distribution of compressed air in the mills. Therefore, an attempt is made to conduct conservation study with the help of high tech instruments.

The objectives of this study are:

(i) To evaluate and analyze the energy efficiency of air compressors using portable online air flow analyzer

(ii) To measure the leakage level of compressed air in the distribution system using digital air leakage meter.

(iii) To fix the standards for compressor efficiency and leakage levels in textile mills.

Compressor Efficiency Analyzer

Compressed air system is a well known and proven technology and it is used in many applications right from blowroom to weaving. In the modern textile machines, compressed air is being used for most of their functions like valve opening, auto doffing, drafting pressure, splicing, Air jet spinning and Air jet weaving. Use of compressed air is increasing day-by-day in textile mills along with increase in energy consumption. Studies reveal that the efficiency of the compressed air system is below 20% and 80% of the energy for generating compressed air is converted into heat energy. So it is vital to avoid loss in the compressed air.

SITRA has conducted many studies on energy consumption of air compressors in order to reduce

the losses in the system. It is found that many mills are not properly monitoring the energy consumption pattern which leads to huge losses. Actual air consumption and the machinery manufacturer data of the individual machines are varying due to air leakage and improper maintenance. After one or two years, actual compressed air consumption increases which forces the mills to increase the compressor capacity.

The layout of the air compressor system also plays an important role in minimizing the losses. Improper layout will increase the pressure drop which necessitates the operation of the compressor at a higher pressure band. Higher the operating pressure, more the energy consumption and air leakage.

SITRA has conducted an in-depth study on compressed air in individual machines and analysed the reason for variation. Air leakage is the major cause for the increased consumption and it can be controlled by systematic maintenance and good quality spare parts.

Compressor Efficiency Analysis

SITRA has conducted a study on air compressors with different capacity and models. A study was conducted in oil free screw compressor installed in a weaving mill having AIRJET looms. The mill was facing acute problems in the compressor air line such as pressure fluctuation, higher power consumption etc. SITRA took up a project to analyze the compressor efficiency by measuring the actual delivery capacity of the compressor using digital air flow meter.This project has been completed

Table 31 Specific Power Consumption of the Compressor at Different Pressure levels

Compressor Details:	TYPE - Screw FAD - 437 CMH Motor - 45 kW		
Operating Pressure (Bar)	Flow rate CMH	Motor Power kW	Specific Power kW/CMH
6	392	41.6	0.106
7.5	392	45.4	0.115
8	373	48.8	0.130
9	361	51.8	0.143
9.5	346	53.2	0.153

Air consumption and leakage measurements were carried out in air jet looms and further study in this area is in progress. A portable air flow analyzer is used to measure the quantum of compressed air consumed by the machines in the mill. The study reveals that there is a good scope for saving energy by means of analyzing air consumption of the looms using flow meters.

A study on Specific Power Consumption of a compressor at different operating pressures shows the following pattern.

Studies conducted in the mills revealed that there is a good scope for 3 to 7% savings in energy by means of using digital air leakage meter. Measurement of air consumption by a portable air flow analyzer and leakage measurements by digital air leakage meter have been carried out for this study.

Compressor Details:	TYPE - Oil free Screw Compressor (water cooled) FAD - 3655 CMH Motor - 355 kW

Table 32 Specific Power Consumption of the Compressors (Oil free screw)

Operating Pressure (Bar)	Designed Capacity FAD in CMH	Measured Capacity FAD in CMH	Motor Power KW	Specific Power KW/CMH
6.4	3420	2730	341+37 .5 (C.T)	0.22

C.T – Cooling tower

ENERGY CONSERVATION STUDY IN TEXTILE HUMIDIFICATION USING ULTRASONIC FOG PRODUCING SYSTEM.

Use of Ultrasonic FOG system is a recent development in textile mill humidification system. Ultrasonic vibration is used to create a misty FOG having water particles in the order of 1 to 3 microns which can readily mix up with air in the department. This system has many advantages as compared to other existing systems used in textile industry. Therefore, an attempt has been made to study the techno economic advantages of the ultrasonic FOG system in a spinning mill under working conditions.

The objectives of this study are:

(i) To study the energy saving advantages of the ultrasonic FOG system in comparison with the existing humidification systems.

(ii) To evaluate the overall performance of the ultrasonic FOG system in the industry.

Ultrasonic FOG system was studied in two mills and our observations are as below.

Mill 1 - The existing distribution system in the mill is not so well designed and after discussing with the mill personnel, a suitable distribution system has been designed to focus the FOG at the required area in the machine for effective conditioning of the material for better performance. Measurements of important parameters like RH% and temperature have been taken with and without FOG system for evaluation. Studies were conducted in Pre-spinning, auto cone winding, open end spinning and TFO doubling departments.

Mill 2 - There is no humidification system in this mill. Studies were conducted in combing and yarn conditioning departments. An increase of 5% in RH (absolute unit) is observed during the trials with fog system.

The advantages of this system are

- does not need nozzles and the fog output is distributed through PVC pipes. Therefore, no issues are faced by mills in terms of nozzle blockages.
- very compact in size and individual units of various capacities are available
- ideal to be used as a supplementary system to the existing humidification systems
- will be suitable for the mills running without conventional humidification plants.

CHEMICAL PROCESSING

AN INNOVATIVE METHOD FOR TREATMENT OF TEXTILE PROCESSING EFFLUENTS

In textile chemical processing, treatment of effluents is a major challenge to the industries. Several methods like coagulation and flocculation, biological method, electro chemical oxidation and reduction, chlorination, etc. are available in the industry for treatment of effluent. These methods are exhaustive, expensive and they invariably result in the generation of hazardous solid waste known as 'Sludge' in large quantities. The sludge requires a large area of space for storage and disposal is also difficult. Moreover, the treatment costs are relatively higher in the existing methods.

Hence, SITRA has developed 'An Innovative method for treating the textile effluents' by altering the chemicals used for decolouration of effluents which effectively decolourises the colour in the effluent. Unlike other methods, this method is suitable for all types of effluents including those which contains disperse dyes. The chemicals used in this method are cheaper and available in plenty. Also, there is some reduction in the Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) while using this method and it results in minimal sludge formation as compared to other methods. SITRA has applied for a patent (Complete patent application no. 5183/CHE/2012 dated 12.12.13) for this method.

Methodology

The conventional methods of decolourisation include passing chlorine gas into the effluent in alkaline medium giving rise to the generation of nascent Oxygen which in turn decolourises the effluent. The novelty of SITRA's chemical oxidation lies in the fact that the decolourisation is done by adding a chemical to the effluent in acidic medium during which nascent Chlorine is liberated. This nascent chlorine is more powerful than the nascent Oxygen in terms of decolourising power and hence results in better decolourising efficiency while the incidence of sludge is practically negligible.

Mill trials conducted

Mill trial 1

Trials were conducted in a mill which was earlier following coagulation & flocculation cum biological method for treating their effluent arising from processing of 100% cotton and blended fabrics using reactive and disperse dyes. Instead of using lime and ferrous sulphate, first the effluent is brought to acidic pH using HCl 30% W/V (3 to 5 ml / lit) and later treated with Sodium hypochlorite 30 gpl available chlorine (3 to 5 ml / lit) in flash mixer. The decolourising of effluent in the process was evident and the effluent was further treated with the regular biological method followed by reverse osmosis treatment to minimize COD, BOD, TDS, etc. The test results of the effluent at various stages are given in Table 33.

Table 33 Characteristics of raw effluent and the effluent treated with SITRA's chemical oxidation method

Parameters	Raw effluent	After decolourisation	Secondary outlet	RO Permeate	RO Reject
pH	7.25	5.2	6.5	6.7	7.91
Colour (Hazen)	680	51	40	10	-
Turbidity (NTU)	38	28	24	ND	37
Total suspended solids (mg/l)	180	178	160	22	576
Chemical oxygen demand (mg/l)	684	520	138	66	1742
Biological oxygen demand (mg/l)	281	210	5.3	ND (upto 5 ppm)	112.6
Total dissolved solids (mg/l)	5664	8176	8075	320	22656

From the above, it can be seen that the colour intensity of the effluent has been reduced by 93% using this method. Further, it was noted that the BOD and COD got reduced significantly, while there was some rise in the TDS.

Mill trial 2

Another trial was conducted in a common effluent treatment plant facility which has been using Chlorine gas for decolourisation of the effluent. Inspite of using the Chlorine gas, some portion of the colour still existed at the secondary treatment outlet stage. Upon their request, SITRA has conducted a trial on the thus treated effluent using the sulphuric acid & sodium hypo chlorite and the results are given in Table 34.

Table 34 Important characteristics of secondary outlet effluent of a CETP and the one further treated with SITRA's chemical oxidation method

Parameters	Secondary outlet before treatment	After treatment using SITRA's method
pH	7.95	5.0
Colour (Hazen)	309	ND (upto 1)
Total dissolved solids (mg/l)	6924	8308
Chemical oxygen demand (mg/l)	305	232
Biological oxygen demand (mg/l)	11.36	ND (upto 5ppm)

From the above table, it is noted that the colour intensity has been reduced to almost nil using SITRA's method.

Summary

- SITRA's chemical oxidation method was found to be more suitable for treating combined effluents of varying characteristics.
- The decolourisation efficiency of this method was found to be 90% to 98 %.
- There is a significant reduction in both COD & BOD using this method.
- It was also found that the TDS increases significantly with the addition of these chemicals owing to the conversion of alkalies / acids in the solution into salts.
- Further trials would be required to study the exact quantity of chemicals required to decolourise effluents having different characteristics.
- Based on the said trials, a ready reckoner shall be prepared to suggest the suitable dosage of chemicals for the various levels of intensities of effluent.

A COMPARATIVE STUDY OF THE DYEING BEHAVIOUR OF VIRGIN AND RECYCLED POLYESTER FIBRES

With the increasing environmental concerns, recycling and reuse of products have become a common phenomenon especially in cases where the raw material used is not bio-degradable. Textile industry is no exception for the above as the share of recycled polyester out of the overall products made of polyester is on the rise continually. Recycled polyester products are those made by recycling used water bottles, used polyester clothes, etc. In this scenario, however, in the downstream processing of textile materials made of recycled polyester fibres, there are issues with regard to consistency in shade, dyeing behaviour and other performance attributes. Hence, SITRA has planned to take-up a project to assess the dyeing behaviour of recycled polyester fibres in comparison with that of virgin polyester fibres (made by polymerizing monomers).

Materials and methods

As a preliminary trial, recycled polyester fibre samples and virgin polyester fibre samples were collected from the mills, dyed in fibre stage in the laboratory and assessed for their dyeability. Thermal characteristics of the raw fibres were also studied. The results are given below:

Differential Scanning Calorimeter (DSC)

DSC is an effective tool to assess the thermal behaviour (i.e) the response of the material at various temperature levels, from room temperature to 400^{0}C. The virgin and recycled polyester fibres were assessed for their thermal behavior in Differential Scanning Calorimeter (DSC) and the thermal graph pertaining to the results are given below:

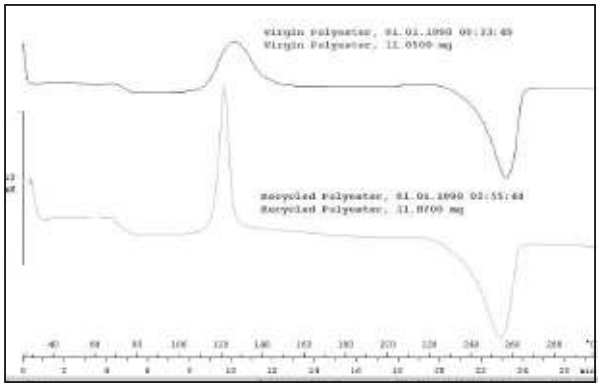
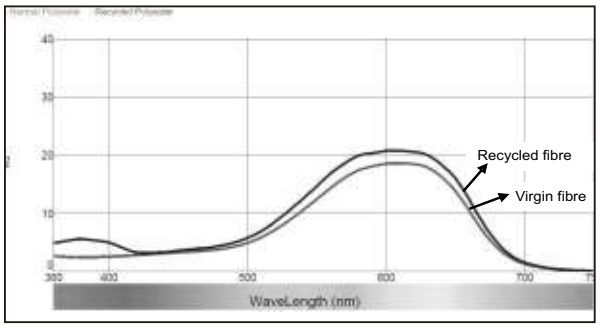


Figure 7 Thermal graphs of virgin and recycled polyester fibres

From the above, it can be seen that there is a significant difference between the thermal behaviour of virgin and recycled polyester fibres. At 120^0 C to 130^0 C, there is a steep peak in the recycled fibre indicating the reorientation of polymers resulting in a higher order of crystallinity.

Dyeing Characteristics

The virgin and recycled polyester fibres were dyed using disperse dye under identical conditions and evaluated for the dyeing behaviour. The dyed fibres were measured for colour difference (DE) and strength of dye. The results of the same are given below:



DE*	DEcmc	%STR-
2.27	1.73	114.26
2.06	1.53	113.91
2.19	1.66	114.06

Figure 8 K/3 curves of virgin and recycled polyester fibres dyed under identical conditions

The results from the trial indicate that the recycled fibres dye darker than virgin fibres to the tune of say 15%. This difference can be attributed to the fact that there is considerable reorientation of molecules in recycled fibres. However, further trials would be required to confirm this.

Summary

As per the preliminary trials conducted at SITRA,

- ✓ Recycled polyester fibres dye darker than that of virgin polyester fibres. More number of trials to be conducted to substantiate this finding. The consistency of shade between lots needs to be assessed in detail.

- ✓ As far as the thermal behaviour of these fibres are concerned, there is significant peak in the recycled fibres; perhaps indicating the re-orientation of polymers during the recycling process.

Further the study need to be extended for a wide range of samples and the samples shall be assessed for their physical and thermal characteristics besides the dyeing behaviour.

A STUDY ON THE EXTENT OF WHITE NEPS REDUCTION THROUGH VARIOUS PROCESS ROUTES WHILE DYEING COTTON FABRICS WITH REACTIVE DYES

The incidence of neps on fabric has been an issue in the market since long. The probable reasons for the white neps / specky dyeing could be 1) use of immature and half mature fibres and excessive use of useable waste during spinning 2) improper chemical processing of the fabric (especially in dark shades) 3) types of dyes and chemicals used during wet processing, etc. Disputes often arise between spinners and chemical processors on the reason for such specky / neppy appearance of the fabric after processing. Though it is known that proper processing of fabrics would minimize the specky / neppy appearance to a great extent, efforts are needed to establish the simulated effects and the extent to which the various process routes followed by the mills play a role in deciding the fabric appearance.

Materials and methods

Compared to matured cotton fibres, immature and half mature cotton fibres have low affinity towards dye stuffs and appear to be undyed or light dyed spots on fabric. A portion of the fibres used in the mixing for spinning may have half matured / immatured fibres which in turn could attribute to neps formation on yarn surface. While dyeing cotton fabrics with darker shades, generally, a few of the processing units prefer to skip the regular pretreatment processes viz., scouring, bleaching, etc to minimise the production cost and directly proceed for dyeing. In such cases, there is a possibility that the fabric thus dyed may have specky / neppy appearance leading to reduction in its value.

SITRA has conducted a few preliminary trials using the knitted fabrics made out of 25s KH yarns and 30s CH yarns. The said fabrics were dyed using the following process routes:

- Wetting agent treated (without scouring) & dyed
- scoured and bleached under normal conditions & dyed

Dye stuff used - Remazol Black B
Depth of shade - 4%

Dyeing was carried out under identical conditions for all the 4 samples.

Results & Discussions

The dyed fabrics processed through the two different routes were evaluated visually by a number of experts at various levels and the ratings in terms of average no. of neps / 10 cm x 10 cm size of dyed fabrics are given in the below table and graph:

Table 35 Average no. of neps per 10cm^2 of fabrics dyed through different process routes

Process route	Avg. no. of neps / 10 cm x 10 cm of fabric	
	25s KH Fabric	30s CH Fabric
Wetting agent treated & dyed	19	11
Scoured, bleached & dyed	15	9

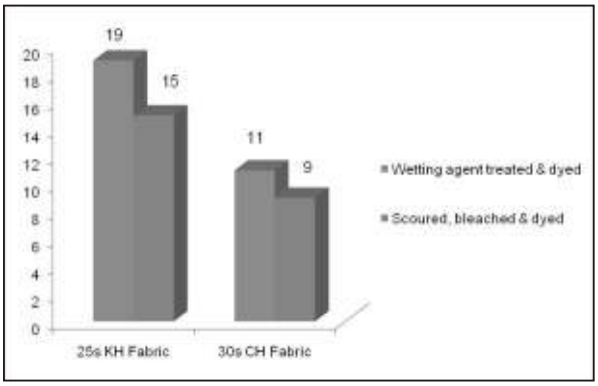


Figure 9 Bar chart showing the average no. of neps per 10cm^2 of fabrics dyed through different process routes

Summary

The subjective assessment of the fabrics dyed through 2 different processes reveals that the fabrics which were given proper pre-treatment (i.e. scouring and bleaching) before dyeing have shown

- 21% lesser white spots in carded hosiery
- 18% lesser white spots in combed hosiery

Further trials are required to study the effect of fibre properties, yarn properties; different processes viz., caustisizing, mercerizing, etc on the fabric appearance.

MEDICAL TEXTILES

HOSPITAL BED LINENS WITH ENHANCED THERMAL PROPERTIES (Sponsored By Ministry of Textiles, Govt. of India, New Delhi)

The main objectives of the project are

- To develop hospital bed linens with improved comfort properties for immobile patients

and

- To compare the quality attributes of those bed linens with that of conventional bed linens used at present.

In general the hospital bed linens are made using either cotton yarns or blends of polyester and cotton yarns. SITRA had developed hospital bed linens in the following two ways.

i) Hospital bed linens with Phase Change Material (PCM) finish,

ii) Hospital bed linens woven using an advanced filament (Luxicool)

1. Hospital bed linens with PCM finish

SITRA has developed four plain weave hospital bed linens with the fabric width of 48 inches. They are

i) 14 Ne Cotton fabric samples,
ii) 14 Ne Polyester/Cotton (P/C) fabric samples,
iii) 2/20 Ne Cotton fabric samples and
iv) 2/20 Ne P/C fabric samples.

The fabric constructional parameters are shown in Table 36. The fabric constructional parameters were chosen from the data provided by AIIMS (All India Institute of Medical Science, New Delhi) and commercially available bed linens that are used in hospitals in and around Coimbatore.

Table 36 Constructional parameters of Hospital bed Linen fabrics

S.No	Fabric type	EPI (Ends per Inch)	PPI (Pick per inch)	Fabric weight (gsm)*
1)	14 Ne Cotton fabric	66	56	175
2)	14 Ne P/C fabric			
3)	2/20 Ne Cotton fabric	36	36	200
4)	2/20 Ne P/C fabric			

* grams per square meter

The 4 fabrics developed by SITRA were desized, scoured, mercerized, bleached and dyed. From the 4 fabric samples, 28 test specimens were produced by using cotton & P/C single and doubled yarns as well as by varying the concentration of PCM finish applied on the specimens. The relevant details are given in Table 37.

Table 37 Details of fabric specimens produced using PCM finish

S.No	Fabric identification code	Yarn count (Ne)	Material composition		PCM concentration (gpl)*	Binder concentration (gpl)
			Warp yarn	Weft yarn		
1)	14 Ne – 1C	14	Cotton	Cotton	50	20
2)	14 Ne – 2C	14	Cotton	Cotton	75	25
3)	14 Ne – 3C	14	Cotton	Cotton	100	30
4)	14 Ne – 4C	14	Cotton	Cotton	125	35
5)	14 Ne – 5C	14	Cotton	Cotton	150	40
6)	14 Ne – 6C	14	Cotton	Cotton	175	45
7)	14 Ne – 7C	14	Cotton	Cotton	200	50
8)	14 Ne – 1PC	14	Polyester/Cotton	Polyester/Cotton	50	20
9)	14 Ne – 2PC	14	Polyester/Cotton	Polyester/Cotton	75	25
10)	14 Ne – 3PC	14	Polyester/Cotton	Polyester/Cotton	100	30
11)	14 Ne – 4PC	14	Polyester/Cotton	Polyester/Cotton	125	35
12)	14 Ne – 5PC	14	Polyester/Cotton	Polyester/Cotton	150	40
13)	14 Ne – 6PC	14	Polyester/Cotton	Polyester/Cotton	175	45
14)	14 Ne – 7PC	14	Polyester/Cotton	Polyester/Cotton	200	50
15)	2/20 Ne – 1C	2/20	Cotton	Cotton	50	20
16)	2/20 Ne – 2C	2/20	Cotton	Cotton	75	25
17)	2/20 Ne – 3C	2/20	Cotton	Cotton	100	30
18)	2/20 Ne – 4C	2/20	Cotton	Cotton	125	35
19)	2/20 Ne – 5C	2/20	Cotton	Cotton	150	40
20)	2/20 Ne – 6C	2/20	Cotton	Cotton	175	45
21)	2/20 Ne – 7C	2/20	Cotton	Cotton	200	50
22)	2/20 Ne – 1PC	2/20	Polyester/Cotton	Polyester/Cotton	50	20
23)	2/20 Ne – 2PC	2/20	Polyester/Cotton	Polyester/Cotton	75	25
24)	2/20 Ne – 3PC	2/20	Polyester/Cotton	Polyester/Cotton	100	30
25)	2/20 Ne – 4PC	2/20	Polyester/Cotton	Polyester/Cotton	125	35
26)	2/20 Ne – 5PC	2/20	Polyester/Cotton	Polyester/Cotton	150	40
27)	2/20 Ne – 6PC	2/20	Polyester/Cotton	Polyester/Cotton	175	45
28)	2/20 Ne – 7PC	2/20	Polyester/Cotton	Polyester/Cotton	200	50

* grams per liter

PCM finish

PCM finish used in this study contains two basic chemicals. They are i) PCM microcapsules and ii) Binder.

PCM microcapsule contains paraffin either in liquid or in solid state. The paraffin is covered by a small plastic sphere with diameter of only a few micrometers. The schematic diagram of the PCM microcapsule materials are shown in Figure 10.

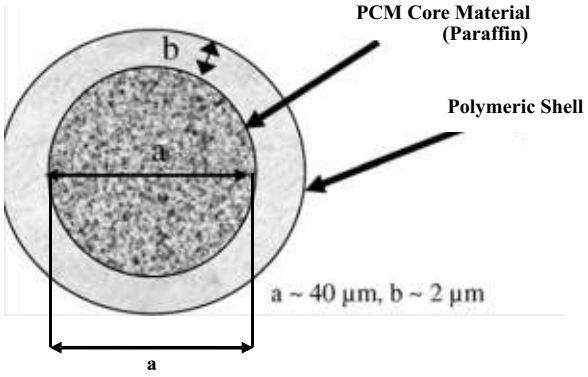


Figure 10 PCM core material with a hard polymeric shell.

Binders play a crucial role in microcapsule coating formulation for various textile materials, as they are required to fix microcapsules on textile materials permanently. To a large extent, binders determine the quality, durability and washability of textile materials with microencapsulated ingredients. Some of the most frequently used binders in textiles are water-soluble polymers such as starch & modified starches, carboxymethyl cellulose; synthetic latexes, such as styrene-butadiene, polyvinylacetate or acrylate latexes; and aminoaldehyde resins.

Hospital bed linens woven using luxicool filament

Plain weave fabrics were produced using luxicool filament yarns with six different weft combinations. A total of 24 fabric samples were produced with different combinations of fiber, yarn linear density and pick arrangement. They are shown in Table 38.

Table 38 Details of fabric specimens produced using Luxicool filament

S.No	Fabric identification Code	Yarn count (Ne)	Material composition		Pick arrangement
			Warp yarn	Weft yarn(s)	
1)	14 Ne Cotton (control sample)*	14	cotton	cotton	Picks/Inch = 56 All picks are Cotton
2)	[illegible]	14	cotton	Luxicool filament & cotton	Luxicool filament – 2 Picks cotton – 2 Picks
3)	14 Ne – 2 CL	14	cotton	Luxicool filament & cotton	Luxicool filament – 2 Picks cotton – 4 Picks
4)	14 Ne – 3 CL	14	cotton	Luxicool filament & cotton	Luxicool filament – 2 Picks cotton – 8 Picks
5)	14 Ne – 4 CL	14	cotton	Luxicool filament & cotton	Luxicool filament – 4 Picks cotton – 8 Picks
6)	14 Ne – 5 CL	14	cotton	Luxicool filament & cotton	Luxicool filament – 4 Picks cotton – 16 Picks
7)	14 Ne P/C (Control sample)	14	P/C	P/C	Picks/Inch = 56 All picks are P/C
8)	14 Ne – 1 P/CL***	14	P/C	Luxicool filament & P/C	Luxicool filament – 2 Picks P/C – 2 Picks
9)	14 Ne – 2 P/CL	14	P/C	Luxicool filament & P/C	Luxicool filament – 2 Picks P/C – 4 Picks
10)	14 Ne – 3 P/CL	14	P/C	Luxicool filament & P/C	Luxicool filament – 2 Picks P/C – 8 Picks
11)	14 Ne – 4 P/CL	14	P/C	Luxicool filament & P/C	Luxicool filament – 4 Picks P/C – 8 Picks
12)	14 Ne – 5 P/CL	14	P/C yarn	Luxicool filament & P/C	Luxicool filament – 4 Picks P/C – 16 Picks

Table 38 Details of fabric specimens produced using Luxicool filament (Contd..)

S.No	Fabric identification Code	Yarn count (Ne)	Material composition		Pick arrangement
			Warp yarn	Weft yarn(s)	
13)	2/20 Ne Cotton (Control sample)	2/20	cotton	cotton	Picks/Inch = 36 All picks are Cotton
14)	2/20 Ne – 1 CL**	2/20	cotton	Luxicool filament & cotton	Luxicool filament – 2 Picks cotton – 2 Picks
15)	2/20 Ne – 2 CL	2/20	cotton	Luxicool filament & cotton	Luxicool filament – 2 Picks cotton – 4 Picks
16)	2/20 Ne – 3 CL	2/20	cotton	Luxicool filament & cotton	Luxicool filament – 2 Picks cotton – 8 Picks
17)	2/20 Ne – 4 CL	2/20	cotton	Luxicool filament & cotton	Luxicool filament – 4 Picks cotton – 8 Picks
18)	2/20 Ne – 5 CL	2/20	cotton	Luxicool filament & cotton	Luxicool filament – 4 Picks cotton – 16 Picks
19)	2/20 Ne P/C (Control sample)	2/20	P/C	P/C	Picks/inch = 36 All picks are P/C
20)	2/20 Ne – 1 P/CL***	2/20	P/C	Luxicool filament & P/C	Luxicool filament – 2 Picks P/C – 2 Picks
21)	2/20 Ne – 2 P/CL	2/20	P/C	Luxicool filament & P/C	Luxicool filament – 2 Picks P/C – 4 Picks
22)	2/20 Ne – 3 P/CL	2/20	P/C	Luxicool filament & P/C	Luxicool filament – 2 Picks P/C – 8 Picks
23)	2/20 Ne – 4 P/CL	2/20	P/C	Luxicool filament & P/C	Luxicool filament – 4 Picks P/C – 8 Picks
24)	2/20 Ne – 5 P/CL	2/20	P/C	Luxicool filament & P/C	Luxicool filament – 4 Picks P/C – 16 Picks

* Control samples are fabric samples woven without using luxicool filament

** Cotton with Luxicool filament; *** P/C fabric with Luxicool filament

Optimization of fabric parameters for improved thermal comfort

Hospital bed linens treated with PCM finish

Thermal conductivity is defined by the time rate of heat flow under steady state conditions, through unit area per unit temperature in the direction perpendicular to the fabric sample. It is expressed in Watt per meter per Kelvin. The thermal conductivity values of PCM finished fabric samples are shown in Table 39.

Table 39 Thermal conductivity values of PCM finished fabric samples

S.No	Fabric identification code	Thermal conductivity (X 10^{-3} W/(m.K))
	PCM finished Cotton fabric samples	
1)	14 Ne – 1C	35.73
2)	14 Ne – 2C	37.30
3)	14 Ne – 3C	39.74
4)	14 Ne – 4C	42.62
5)	14 Ne – 5C	45.58
6)	14 Ne – 6C	48.49
7)	14 Ne – 7C	45.34

Table 39 Thermal conductivity values of PCM finished fabric samples (Contd..)

S.No	Fabric identification code	Thermal conductivity (X 10 $^{-3}$ W/(m.K))
	PCM finished P/C fabric samples	
8)	14 Ne – 1PC	29.46
9)	14 Ne – 2PC	30.93
10)	14 Ne – 3PC	32.61
11)	14 Ne – 4PC	34.74
12)	14 Ne – 5PC	37.06
13)	14 Ne – 6PC	39.32
14)	14 Ne – 7PC	36.86
	PCM finished Cotton fabric samples	
15)	2/20 Ne – 1C	38.76
16)	2/20 Ne – 2C	40.91
17)	2/20 Ne – 3C	43.59
18)	2/20 Ne – 4C	46.60
19)	2/20 Ne – 5C	49.18
20)	2/20 Ne – 6C	52.32
21)	2/20 Ne – 7C	49.31
	PCM finished P/C fabric samples	
22)	2/20 Ne – 1PC	31.46
23)	2/20 Ne – 2PC	33.56
24)	2/20 Ne – 3PC	35.70
25)	2/20 Ne – 4PC	37.88
26)	2/20 Ne – 5PC	40.41
27)	2/20 Ne – 6PC	42.76
28)	2/20 Ne – 7PC	39.98

Higher values of thermal conductivity are better for fabrics meant for hospital bed linens. Higher values of thermal conductivity were observed for i) 14 Ne – 6C, ii) 14 Ne – 6 P/C, iii) 2/20 Ne – 6 C and iv) 2/20 Ne – 6 P/C

Luxicool incorporated hospital bed linen fabrics

The thermal conductivity values of Luxicool incorporated hospital bed linen fabrics are shown in Table 40.

Table 40 Thermal conductivity values of Luxicool incorporated fabric samples

S.No	Fabric identification code	Thermal conductivity (X 10 $^{-3}$ W/(m.K))
1)	14 Ne Cotton (Control sample)	36.30
2)	14 Ne – 1 CL*	42.90
3)	14 Ne – 2 CL	42.48
4)	14 Ne – 3 CL	38.56
5)	14 Ne – 4 CL	40.83
6)	14 Ne – 5 CL	37.48
7)	14 Ne P/C (Control sample)	27.14
8)	14 Ne – 1 P/CL**	31.01
9)	14 – 2 P/CL	29.25
10)	14 – 3 P/CL	27.86
11)	14 – 4 P/CL	30.23
12)	14 5 P/CL	28.27

Table 40 Thermal conductivity values of Luxicool incorporated fabric samples (Contd..)

S.No	Fabric identification code	Thermal conductivity (X 10^{-3} W/(m.K))
13)	2/20 Cotton (Control sample)	38.95
14)	2/20 – 1 CL*	45.95
15)	2/20 – 2 CL	43.59
16)	2/20 – 3 CL	42.87
17)	2/20 – 4 CL	44.70
18)	2/20 – 5 CL	43.20
19)	2/20 P/C (Control sample)	32.87
20)	2/20 – 1 P/CL**	37.80
21)	2/20 – 2 P/CL	35.31
22)	2/20 – 3 P/CL	33.14
23)	2/20 – 4 P/CL	35.07
24)	2/20 – 5 P/CL	34.17

* Cotton with Luxicool filament; ** P/C with Luxicool filament

Higher values of thermal conductivity were observed for

I) 14 Ne cotton fabrics incorporated with Luxicool filament
(Pick arrangement: Cotton – 2 picks; Luxicool – 2 picks)
ii) 14 Ne P/C fabrics incorporated with Luxicool filament
(Pick arrangement: P/C – 2 picks; Luxicool – 2 picks)
iii) 2/20 Ne cotton fabrics incorporated with Luxicool filament
(Pick arrangement: Cotton – 2 picks; Luxicool – 2 picks)
iv) 2/20 Ne P/C fabrics incorporated with Luxicool filament
(Pick arrangement: P/C – 2 picks; Luxicool – 2 picks)

Thermal conductivity

Table 41 gives thermal conductivity values of PCM finished and Luxicool incorporated cotton and P/C blended yarn fabrics together with that of untreated samples.

The thermal conductivity values of 14 Ne PCM finished fabrics are 30 to 45 % higher than that of untreated fabrics. The thermal conductivity values of 2/20 Ne PCM finished fabrics are roughly 30 % higher than that of untreated fabrics.

In case of Luxicool incorporated fabrics, the thermal conductivity values of both 14 and 2/20 Ne fabrics are higher as compared to that of untreated fabrics by 15 to 20%.

Table 41 Thermal conductivity values of untreated and treated (PCM finished and Luxicool incorporated) fabric samples

S.No	Type of fabric	Thermal conductivity (X 10^{-3} W/(m.K))		
		Untreated fabric sample	PCM finish applied fabric sample	Luxicool incorporated fabric sample
1)	14 Ne Cotton fabrics	36.30	48.49	42.90
2)	14 Ne P/C fabrics	27.14	39.32	31.01
3)	2/20 Ne Cotton fabrics	38.95	52.32	45.95
4)	2/20 Ne P/C fabrics	32.87	42.76	37.80

This would imply that both PCM finished and Luxicool incorporated fabrics have higher thermal conductivity as compared to untreated fabrics. Between the two, PCM finished fabrics score better.

The project has been completed and a terminal report highlighting the major findings of the study has already been submitted to The Ministry of Textiles.

DEVELOPMENT OF WOUND DRESSINGS MADE OF ELECTRO SPUN HERBAL DRUG AND ALLOPATHIC DRUG INCORPORATED IN PCL NANOMEMBRANE
(Sponsored by the Ministry of Textiles, Government of India, New Delhi)

The objectives of the project are

i) To develop wound dressings using electrospun herbal drug incorporated nanomembrane.

ii) To develop wound dressings using electrospun allopathic drug incorporated nanomembrane.

and

iii) To compare the performance of the newly developed wound dressings with the commercially available wound dressings.

PCL (Poly ε-caprolactone) is a semi crystalline aliphatic polyester. It can be synthesized at room temperature and it is non-toxic. The rate of degradation of the products made out of PCL is very slow.

A 15% PCL concentration solution was prepared using chloroform, methanol & PCL pallet. Allopathic drug viz) Tetracycline hydrochloride (TH) was blended with the PCL solution and the drug incorporated solution was used to prepare nanomembrane wound dressings.

Similarly, 4 different types of herbal drugs viz) i) Tecomella undulate (TU), ii) Glycyrrhiza glabra (GG), iii) Asparagus recemosus (AR) & iv) Linum usitatissimum (LU) were blended individually with the PCL solution and those drug loaded solutions (4 in no) were used to prepare 4 types of nanomembrane wound dressings.

Performance evaluation of allopathic & herbal drug incorporated wound dressings

Morphology of drug-free and drug-loaded wound dressings

The morphology of the nanofiber wound dressings was observed using scanning electron microscope (SEM). The electrospun fibers were sputtered using thin layer of gold prior to SEM observation. On the basis of SEM images, the average diameter of the electrospun fibers could be measured. SEM morphologies of electrospun wound dressings are presented in Fig. 11a, Fig. 11b, Fig. 11c, Fig. 11d, Fig. 11e and Fig. 11f. The fibers possess the common features of being round-shaped with smooth surface. The drug-free and the drug-loaded PCL nano fibres appeared smooth. No drug crystals were detected on the polymer surface of the drug loaded wound dressings.

This suggests that drug was dispersed homogeneously in the electrospun fibres. The diameter of the fibers was in the range of 200 to 250 nm for drug free fibers and 250-300 nm on incorporation of the drugs.

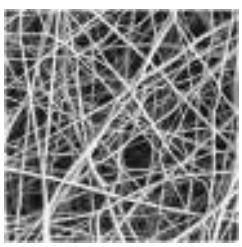


Figure 11 (a)

Figure 11 (b)

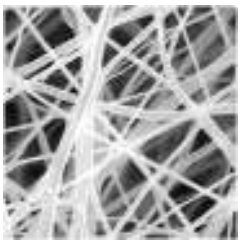


Figure 11 (c)

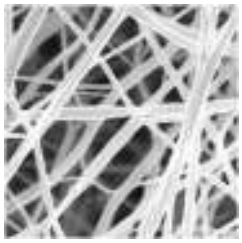


Figure 11 (d)

Figure 11 (e)

Figure 11 (f)

Figure 11(a) PCL Nanomembrane, Figure 11 (b) Allopathic drug incorporated wound dressing (ADWD), Figure 11 (c) Tecomella undulate drug incorporated wound dressing (TUWD), Figure 11 (d) Glycyrrhiza glabra drug incorporated wound dressing (GGWD), Figure 11 (e) Asparagus recemosus drug incorporated wound dressing (ARWD) & Figure 11 (f) Linum usitatissimum drug incorporated wound dressing (LUWD)

Moisture vapor transmission rate (MVTR)

The MVTR is an important criteria for an wound dressings. The liquid formed inside the wound layer first changes to vapour state and then transported to atmosphere. This moisture vapour transmission helps to heal the wound: otherwise there will be wound infection. The MVTR was determined according to BS EN 13726-2:2002.

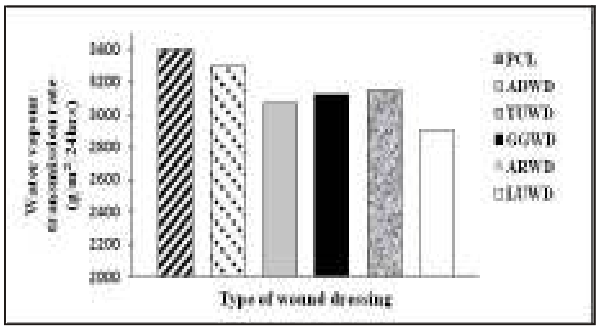


Figure 12 MVTR properties of Allopathic and herbal drug incorporated wound dressings

PCL – Poly(ε-caprolactone) Nanomembrane
ADWD – Allopathic drug incorporated wound dressing
TUWD – Tecomella undulate drug incorporated wound dressing
GGWD – Glycyrrhiza glabra drug incorporated wound dressing
ARWD – Asparagus recemosus drug incorporated wound dressing
LUWD – Linum usitatissimum drug incorporated wound dressing

Allopathic and herbal drug incorporated PCL wound dressing specimens exhibit good MVTR properties in the range of 2900-3300 g/m^2 per day (Figure 12). For an infected skin, MVTR value of 2000 to 2500 is good. Hence, all the nanomembrane substrates made in this study can be considered as suitable for infected skins. The rate of water vapour transmission for normal skin is 700–1200 g/m^2 per day, while for the injured skin it can range from 800 to1300 g/m^2 per day and for a third-degree burn, it can go up to 10000 g/m^2 per day. An ideal wound dressing is expected to control the evaporative water loss from a wound at an optimal rate. The water vapor permeability of a wound dressing should prevent both excessive dehydration and build-up of exudate.

In vitro drug release study

A piece of drug-containing fiber mat (0.1 g) was first placed in a vial filled with 10 mL of release medium acetate buffer. Drug release studies were carried out at 37^{0}C and 100 rotation/min (rpm) in a thermostatical shaking incubator. The releasing medium acetate buffer with pH 5.5 was prepared by dissolving 1.5 g of sodium acetate in 1.5 mL of glacial acetic acid and then the final solution was made up to 100 mL by adding distilled water. In this case, 1.5 mL of sample was taken from the medium after appropriate intervals for about 24 h and then the same volume of fresh release medium was added as replacement. A calibration curve was obtained for the herbal drug concentration at a peak absorption wavelength of nm and a linear equation was derived by a curve-fitting method. In the assessment of drug release behavior, a cumulated amount of the released drug was calculated. The percentages of drug released from the nanofibers were plotted against time.

A drug released from the drug-loaded (allopathic and herbal) nanofibers was in vitro examined for a period of 24 h, and a relationship between the cumulative percentage and releasing time was plotted in Figure 13. Drug release from the nanofibers showed a low initial rapid release followed by a sustained and slow release over a prolonged period of time. Initial rapid release is because the drug came out only when the polymer started to degrade or after water penetrated sufficiently into the nanofibers.

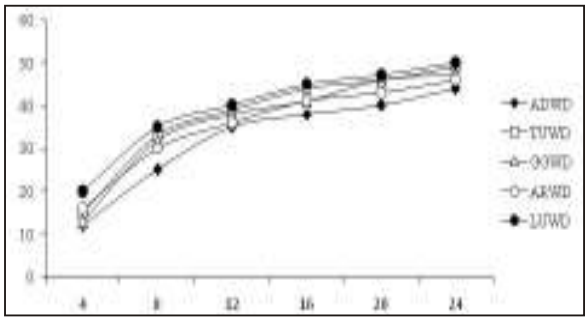


Figure 13 Invitro drug release study of drug incorprated (allopathic and herbal) PCL wound dressings

ADWD – Allopathic drug incorporated wound dressing
TUWD – Tecomella undulate drug incorporated wound dressing
GGWD – Glycyrrhiza glabra drug incorporated wound dressing
ARWD – Asparagus recemosus drug incorporated wound dressing
LUWD – Linum usitatissimum drug incorporated wound dressing

The release profile from the drug incorporated wound dressing exhibited a drug release of about 12-20% in the first 4 h and around 45-50 of the total

drug in the later 24 h. The release model of the wound dressings suggest that both allopathic and herbal drug incorporated wound dressings are suitable to eradicate bacteria in a relatively shorter period of time (through release of larger amount of drug).

Field trails

Skin irritation

The Allopathic and herbal drug incorporated wound dressing specimens were evaluated for potential skin irritation when they are used for covering the wound. The evaluation was as per ASTM F 719-81 standard.

Standard test method for assessing skin irritation (ASTM F 719 – 81 standard)

- **Principle of Measurement**

Exposure of skin to the test material is accomplished by means of a patch test technique employing two intact sites on the back of each of six albino rabbits. The skin is clipped free of hair one day prior to testing. The test substance is applied using 0.5 ml for liquids, 0.5 g for solids or semisolids and a 2.5 by 2.5 cm square patch for films. After application, each test site is covered with a 2.5 by 2.5 cm gauze flat and the entire trunk is occluded with a polyethylene sleeve. After 24 hours the sleeve, flat and test material are removed and test sites are evaluated for erythema and edema.

- **Scoring Method**

Using the criteria given in Table 42, the test sites are scored for Erythema (ER) and Edema (ED)

Test sites can also be scored for erythema and edema at 48 hours as well as 72 hours after removal (as per the usage requirement) using the criteria given in Table 42.

Thirty healthy rabbits were selected for the study and they were separated into five groups. The Allopathic drug incorporated wound dressing (ADWD) was used with group I, Tecomella undulate drug incorporated wound dressing (TUWD) was used with group II rabbits, Glycyrrhiza glabra drug incorporated wound dressing (GGWD) was used with group III rabbits, Asparagus recemosus herbal drug incorporated wound dressing (ARWD) was used with group IV rabbits and Linum usitatissimum drug incorporated wound dressing (LUWD) was used with group V rabbits.

The study has shown that both allopathic as well as herbal drug incorporated wound dressing do not cause any skin irritation even after 72 hours of contact with the wound.

Wound healing rate

The extent of wound healing provided by a given wound dressing was evaluated using the method proposed by Morton & Malone. As per this method, thirty six healthy rats were employed for the experimentation and they were separated into 6

Table 42 Scoring criteria for test reactions

Reaction	Description	Score
Erythema (ER)	<u>Erythema and Eschar</u> No erythema Very slight erythema (barely perceptible) Well-defined erythema (pale red in colour) Moderate to severe erythema (red and area well defined) Severe erythema (beet redness to slight eschar formation)	 0 1 2 3 4
Edema (ED)	<u>Edema formation</u> No edema Very slight (barely perceptible) Slight edema (edges of area well defined by definite raising) Moderate edema (edges raised approximately 1mm) Severe edema (raised more than 1mm and extending beyond area of exposure)	 0 1 2 3 4

groups (Group I, Group II, Group III, Group IV, Group V and Group VI) each with 6 rats. Excision of wounds was made on the rate as per the method suggested by Morton & Malone. The rats were anaesthetized with anaesthetic ether and placed in operation table in their natural position. A square wound of about 1.5 cm (width) x 0.2 cm (depth) was made on depilated ethanol-sterilized dorsal thoracic region of rats. Infection was made on wounds by staphylococci aureus.

- Ø Group I rats were treated with commercial wound dressing (CWD)
- Ø Group II rats were treated with Allopathic drug incorporated wound dressing (ADWD)
- Ø Group III rats were treated with Tecomella undulate herbal drug incorporated wound dressing (TUWD),
- Ø Group IV rats were treated with Glycyrrhiza glabra herbal drug incorporated wound dressing (GGWD)
- Ø Group V rats were treated with Asparagus recemosus herbal drug incorporated wound dressing (ARWD)
- Ø Group VI rats were treated with Linum usitatissimum herbal drug incorporated wound dressing (LUWD)

The dressings were applied on the wounds of the rats every day till the epithelialization was complete. The extent of wound contraction was studied by tracing the raw wound area in a tracing paper on 6th day, 12th day, 18th day and 24th day.

Determination of wound healing rate

The weight of the traced portions of the wounded area of rats subjected to different treatments (CWD, ADWD, TUWD, GGWD, ARWD and LUWD treated wound) were measured using electronic balance. Based on the difference in weight, the superiority or otherwise of a particular wound dressing is determined. Figure 14 shows CWD, ADWD, TUWD, GGWD, ARWD and LUWD treated wound.

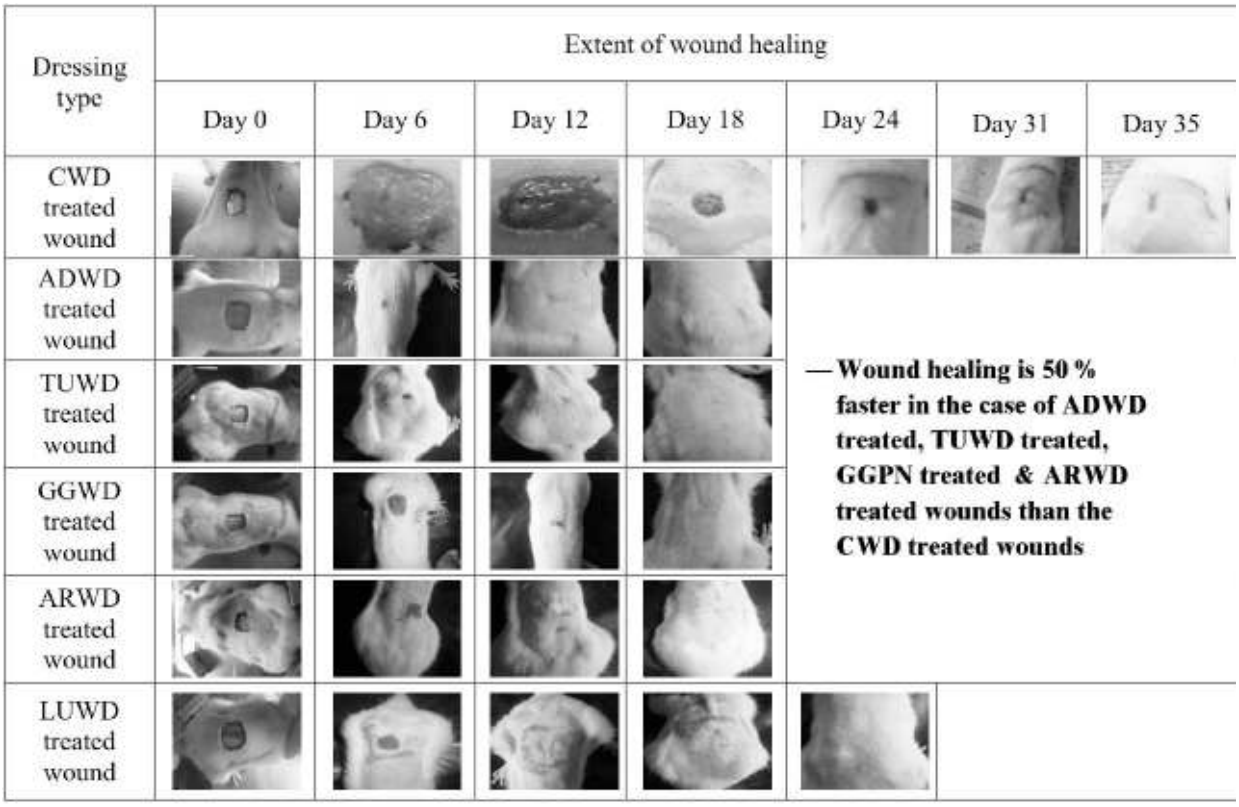


Figure 14 Healing in open CWD, ADPN, TUPN,GGPN, ARPN and LUPN treated wound

1*- CWD treated wound, 2*- ADWD treated wound, 3*- TUWD treated wound,4*- GGWD treated wound, 5*- ARWD treated wound and 6*-LUWD treated wound

Table 43 shows the weight of the traced portions of the wounds on different days

Table 43 Weight of the traced portions of wounds on different days

Dressing type	Percentage reduction of wound size						
	Day 0	Day 6	Day 12	Day 18	Day 24	Day 31	Day 35
CWD treated wound	100	147.45	103.62	74.22	35.08	8.31	2.42
ADWD treated wound	100	56.99	19.6	0			
TUWD treated wound	100	70.21	23.78	0			
GGWD treated wound	100	68.4	27.3	0			
GGWD treated wound	100	75.47	33.45	0			
ARWD treated wound	100	72.69	32.14	0			
LUWD treated wound	100	90.06	45.59	21.38	0		

It is clear from Table 43 that there is a decrease in wound area with the application of the wound dressings. The reduction in the wound area is faster in the case of wounds dressed using SITRA developed wound dressings. The extent of wound healing provided by the SITRA developed allopathic and herbal drug incorporated wound dressings (ADWD, TUWD, GGWD, ARWD and LUWD) is around 50% faster as compared to that using CWD.

The project has been completed and a terminal report highlighting the salient findings of the study has already been submitted to the Ministry of Textiles, Govt. of India.

DEVELOPMENT OF TEXTILE MATRICES FOR THE EFFECTIVE WOUND MANAGEMENT (Sponsored by the Ministry of Textiles, Government of India, New Delhi)

The major objectives of the project are

(i) To develop a wound dressing for promoting angiogenesis by mechanical stimulation.

and

(ii) To develop a wound dressing incorporated with angiogenesis inducing growth factor.

Rationale

Activation of pathways such as hemostasis, inflammation, proliferation and remodeling determines the rate of healing of specific type of wounds. Literature shows the disturbances/impairment in this orderly progression of healing process particularly angiogenesis of granulation phase when the wound encounters with diabetes, venous and arterial insufficiency. Angiogenesis is crucial for wound repair since the new vessels provide nutrients to support the active cells, promote granulation tissue formation and facilitate the clearance of debris. Approximately 60% of the granulation tissue mass is composed of blood vessels supplies the necessary oxygen to stimulate repair and vessel growth. Therefore, in this project, it is planned to develop textile matrices by embroidery technology for the stimulation of angiogenesis in chronic wounds.

Wound dressings developed using embroidery technology

SITRA has developed a 3 layered wound dressing as shown in Figure 15.

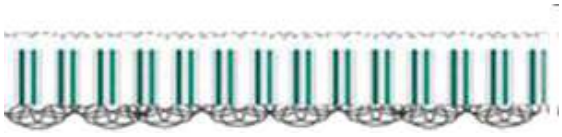


Figure 15 SITRA's 3 layered wound dressing (S3LWD)

The functions of the 3 layers are explained in Table 44.

Table 44 Functions of different layers in S3LWD

Layer	Functions
A	Mechanical and biological protection Control of humidity and air transport
B	Mechanical protection by shear compliance Transfer of compressive forces Absorption and accumulation of wound exudates
C	Angiopolar layer for tissue ingrowth and directed angiogenesis Locally controlled mechanical stimulation of wound area This is the embroidered textile layer

Embroidery technology allows producing a 3D structure textile architecture that combines pores of different sizes (Figures 16 & 17) for directed angiogenesis and elements for local mechanical stimulation.

This structure helps for uptake of blood coagula and for the formation of granulation tissue.

Pore size 10µm to 100µm is primarily for ingrowth of cells & small capillaries and pore size 100 µm to 500 µm for ingrowth of blood vessels.

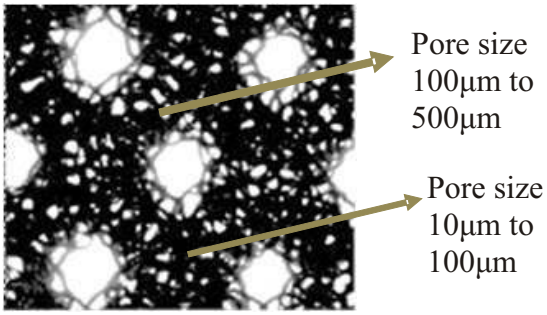


Figure 16 Embroidered textile structure with pore size 10µm to 500µm.

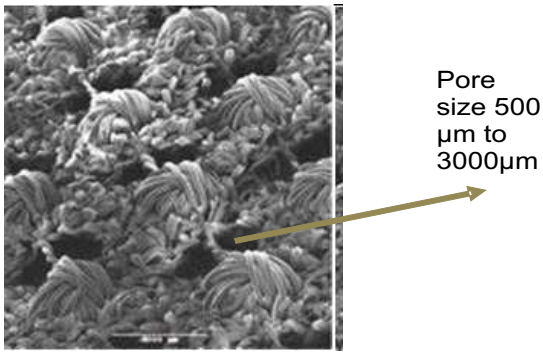


Figure 17 Embroidered textile structure with pore size 500µm to 3000µm.

Combining all the pore sizes (from 10 µm to 3000 µm) an embroidered textile structure was made using CAD and the same is shown in Figure18.

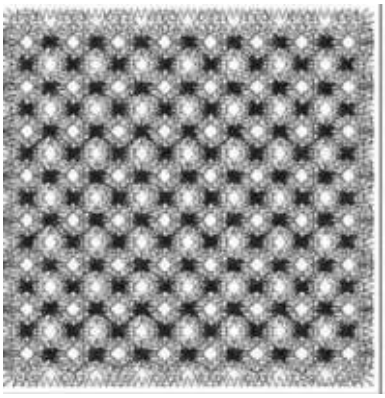


Figure 18 Embroidered textile design developed by SITRA

Performance evaluation of the embroidered wound dressing is in progress.

Chemical stimulation of angiogenesis through use of growth factors in wound dressings

Rationale

In spite of various biodegradable polymers, PLGA (Poly lactic co – glycolic acid) has attracted immense interest over the last 2 decades due to its favorable properties such as good biocompatibility, biodegradability, low immunogenicity, low toxicity and mechanical strength. PLGA's are easy to formulate into different devices for delivering a variety of drug classes such as vaccines, peptides, proteins and other macro molecules. Also, PLGA is the only polymer approved by FDA for drug delivery applications. Hence, PLGA is chosen for delivering angiogenesis stimulating growth factor. However, the literature suggested to use a carrier like

poloxamer along with PLGA to avoid its acidic oligomer based degradation of growth factor. Therefore, PLGA: poloxamer combination is planned to use for encapsulating growth factor. Since, PDGF BB, a platelet derived growth factor is accepted by FDA for the treatment of chronic wounds, periodontal regeneration etc. It is planned to choose PDGF BB for the present study.

PDGF BB loaded PLGA: Poloxamer blend based nanoparticles with a PLGA: poloxamer mass ratio of 1:1 were prepared by a modified solvent diffusion technique.

Physical characterization of PLGA:Poloxamer nanoparticles

The nanoparticles morphology was analyzed by field emission scanning electron microscope using 10 µL of nanoparticles aqueous suspension (~2 mg of nanoparticles/mL) sputter coated with gold.

FeSEM analysis

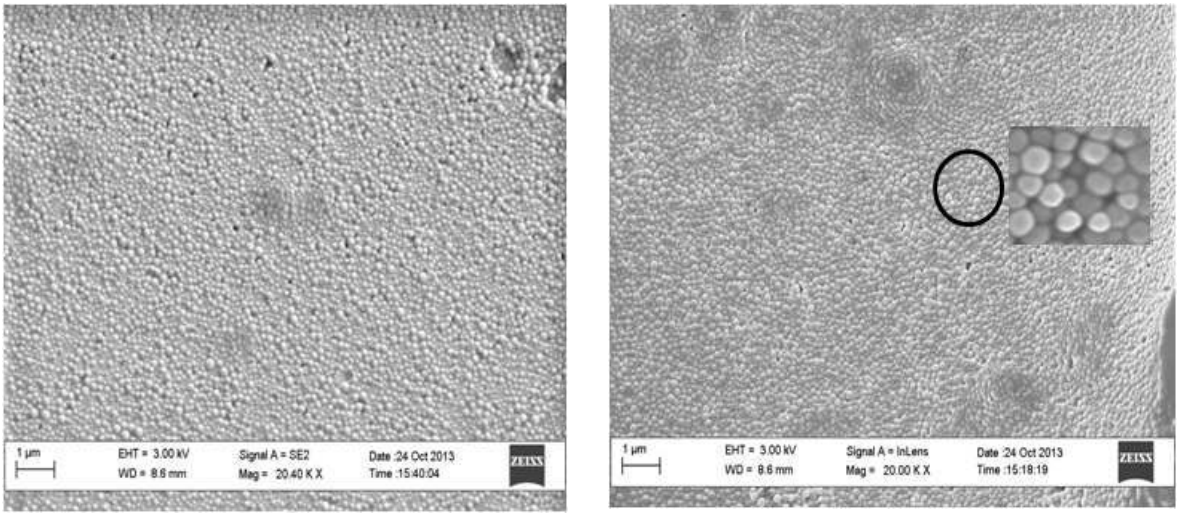


Figure 19 Fe SEM images of PLGA:Poloxamer blend nanoparticles loaded with PDGF BB (colloidal suspension)

PDGF BB loaded PLGA:poloxamer blend nanoparticles were characterized by FeSEM (Figure 19). As indicated in Figure 19, the nanoparticles showed a spherical and regular morphology, which was in agreement with the particles usually obtained by this preparation technique. Additionally, FeSEM images presented homogenous particle size distribution in the ranges of 100 – 150 nm (which needs to be confirmed using particle size analyzer). From the FeSEM micrographs, it is identified that these nanoparticles are swathed by a loose shell, typically observed for PLGA: poloxamer nanoparticles and that has been attributed to the presence of a fraction of the poloxamer on the surface of the nanostructure.

In vitro cytotoxicity and proliferation activity of PDGF loaded PLGA : Poloxamer blend nanoparticles

Nanoparticles' cytotoxicity and proliferation assays were carried out in a liver cancer cell line (Hep G2), by a cell viability assay (MTT) based on mitochondrial activity. Grouyps of the experiment are as follows:

Group 1 : PLGA nanoparticles (blank)
Group 2: PLGA: Poloxamer blend nanoparticles (positive control)
Group 3: PDGF loaded PLGA : Poloxamer blend nanoparticles

For this assay, nanoparticles were diluted in cell medium to 4 different concentrations: 0.25 mg/mL, 0.5 mg/mL, 0.75 mg/mL, and 1 mg/mL,; Further, cytotoxicity and proliferation assays were performed

In vitro cytotoxicity and proliferation activity of PDGF BB loaded PLGA: Poloxamer blend nanoparticles

Considering the potential use of this formulation for the parenteral administration in drug delivery, we intended to characterize the toxicity and proliferation profiles of polymer (PLGA): carrier (poloxamer) and growth factor (PDGF BB) respectively. For this assay, PLGA: poloxamer

blend nanoparticles were incubated with $1x10^4$ Hep G2 cells/mL for 24 h at 37 ºC. Cytotoxicity was measured by MTT reduction assay, solubilizing formazan crystals formed after 5 h of treatment.

The result of the study exhibited cell viability close to 100 % for the range of nano particle concentration tested. In some cases, the readouts from the groups treated with PDGF BB loaded PLGA:poloxamer blend nanoparticles were even higher than the control. These results were in line with the previous studies on MCF-7 breast cancer cell line and were attributed to the presence of poloxamer in the nanoparticles matrix. However, the solvent control, DCM exhibited cytotoxicity of ~ 31 % which needs to be taken care of.

As a preliminary study, SITRA has chosen liver cancer cell line to evaluate the cytotoxicity of PLGA: poloxamer and proliferating ability of PDGF BB.

Performance evaluation of the wound dressings with chemical stimulation of angiogenesis is in progress

DEVELOPMENT OF A LEUKO-DEPLETION BLOOD FILTER
(Sponsored by: Ministry of Textiles, Government of India)

The main objectives of the project are:

- Ø To develop a sub micron filter for removing leukocytes from blood and its components before blood transfusion.
- Ø To filter the other impurities present in the blood components

Normally, 7%-8% of human body's weight is from blood. This essential fluid carries out the critical functions of transporting oxygen and nutrients to our cells and getting rid of carbon dioxide, ammonia, and other waste products. In addition, it plays a vital role in our immune system and in maintaining a relatively constant body temperature. Blood is a highly specialized tissue composed of more than 4,000 different kinds of components. Four of the most important ones are red cells, white cells, platelets, and plasma.

Leukocytes are white blood cells, the body produces leukocytes to help fight off foreign substances in the body such as bacteria, viruses and abnormal cells in an effort to avoid sickness or disease. However, when leukocytes are transfused into another person, with red blood cells, platelets or plasma, they are not well tolerated and have been associated with some types of transfusion reactions.

Leuko-depletion is a process by which leucocytes are removed from donated blood. It has been estimated that the average content of leucocytes in donated human whole blood is 10^9 / unit. By the current standards, the total content leucocytes in a blood unit should be less than 5×10^6/unit after preparation and a minimum of 85% of whole blood or red cells is retained.

One of the methods used to remove leukocytes from blood components by use of textile fibre pads/non-woven. Various fibre webs like cotton wool, cellulose acetate, nylon, nylon wool, polyester, micro denier polyester, micro denier glass fibre, etc. are used in leukocytes filters. Presently, micro denier polyester, micro denier nylon, micro denier glass fibre made filters are commercially available in some foreign countries.

In this project it is proposed to develop leuko-depletion blood filter using sub micro denier polyester (PET) fiber, sub micro denier Nylon 6 (PA 6) fiber and sub micro denier polybutylene terephthalate (PBT) fiber. The hydro-entanglement and electrospining process is used to prepare the webs.

Work done

Polyester non-woven fabric were processed by hydro entanglement technique as shown in Figure 20.

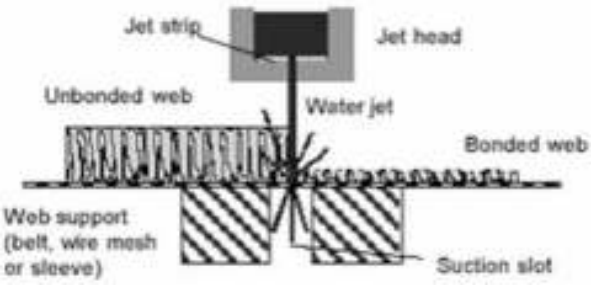


Figure 20 Schematic representation on of Hydro-entanglement process

The polyester non-woven web is tested for weight per sq. meter (GSM) and pore size using capillary flow porometer, the test results are given in Table 45.

Table 45 Unit area weight and pore size of spun lace polyester non-woven web

S. No.	Test	Result
1.	Weight per square meter (GSM) (g)	58.89
2.	Mean pore size (Micron)	29.75

The electro-spinning method is used to produce the submicron level non-woven of polyester (PET), nylon 6 (PA 6) and polybutylene terephthalate (PBT) polymers. The Figure 21 shows the electro spinning set up.

The Table 46 shows the solution parameter and process parameter used to optimize the electro spun nano fibre.

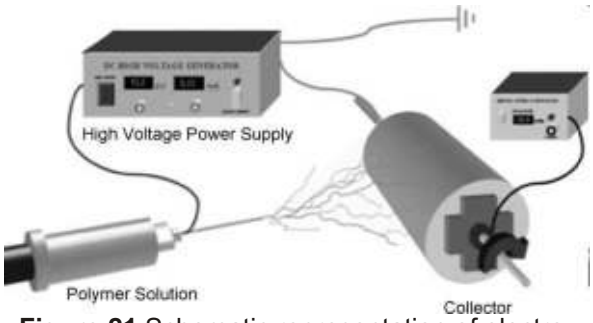


Figure 21 Schematic representation of electro-spinning set-up

The 9 different combinations of trials are taken for each concentration of polymers and optimizing the process parameter on the basis of finer fibre diameter. Because, finer the fibre, rise the filtration. The Table 47 shows optimized electrospining process parameters of polymers. The average fibre diameter is measured by Field emission – scanning electron microscope (FE-

Table 46 Solution details and process parameters of electro-spinning

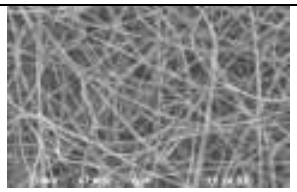
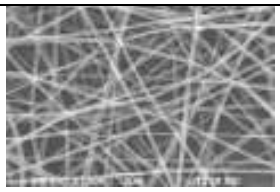
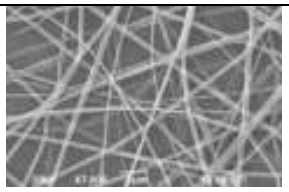
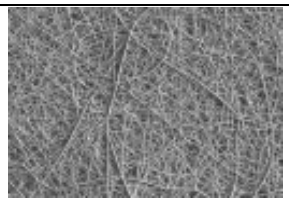
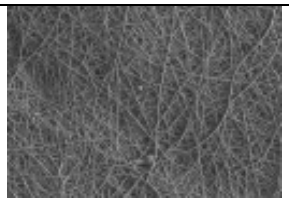
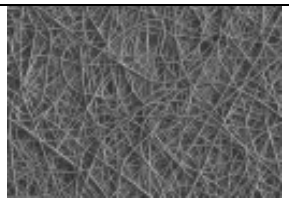
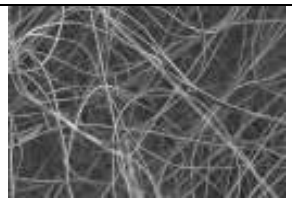
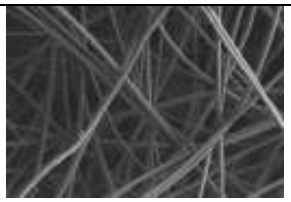
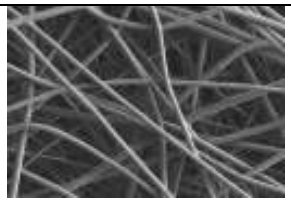
Polymers (Solvents)	Solution Parameter	Process parameters		
	Polymer Concentration (%)	Applied voltage (kV)	Flow rate (ml/hr)	Tip to collector distance (cm)
PET (Dichloromethane and Trifluoroacetic acid)	25, 30, 35	12, 15, 18	0.2, 0.5, 1.0	7, 10, 13
PA 6 (Formic acid)				
PBT (Trifluoroacetic acid)	20, 25, 30			

Table 47 Optimized electro-spinning process parameters of polymers

Polymers (Concentrations)	Optimized values			Avg. fibre diameter (nm)
	Applied voltage (kV)	Flow rate (ml/hr)	Tip to collector distance (cm)	
PET (25%)	15	1.0	13	150
PET (30%)	15	0.5	13	170
PET (35%)	18	0.5	13	320
PA 6 (25%)	15	0.5	10	120
PA 6 (30%)	18	0.5	13	130
PA 6 (35%)	18	0.5	13	160
PBT (20%)	12	1.0	10	630
PBT (25%)	15	0.5	10	1100
PBT (30%)	15	0.5	13	1200

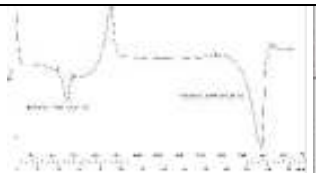
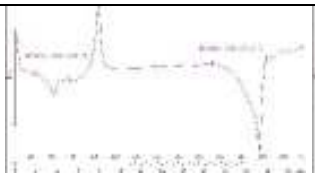
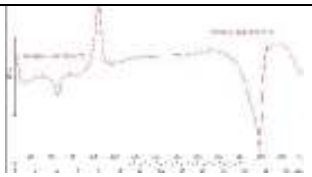
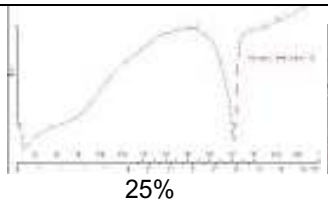
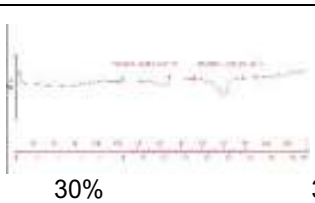
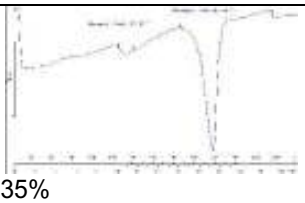
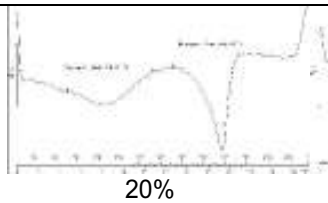
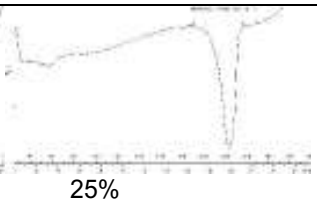
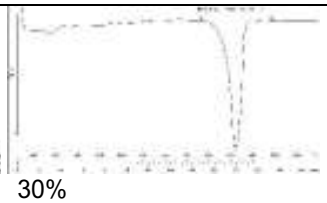
The FE-SEM Images of optimized electro-spun polymer fibers are shown in Table 48.

Table 48 FESEM images of the optimized electro-spun polymer fibres

Polymers	FESEM Images		
PET			
	25%	30%	35%
PA 6			
	25%	30%	35%
PBT			
	20%	25%	30%
(Polymer concentration in percentage)			

The electro-spun polymer fibers are analyzed using the differential scanning calorimetry (DSC) to determine their thermal transitions. DSC can also be used to study oxidation, as well as other chemical reactions. Table 49 shows the DSC curve and the peaks of electro-spun polymer fibers.

Table 49 DSC curves of electro-spun polymer fibers

Polymers	DSC Curves		
PET			
	25%	30%	35%
PA 6			
	25%	30%	35%
PBT			
	20%	25%	30%
(polymer concentration in percentage)			

From the DSC analysis, the curve shows the melting point of PET of 25%, 30% & 35% as 257.79 ˚C, 257.05 ˚C & 258.72 ˚C respectively. Melting point of PA 6 of 25%, 30% & 35% as 220.66 ˚C, 221.31 ˚C & 217.71 ˚C respectively. Melting point of PBT of 20%, 25% & 30% as 218.04 ˚C, 223.62 ˚C & 224.71 ˚C respectively. From these observations, there are no significant differences in melting points of different concentration of polymer fibers.

Work to be carried out to complete the project

- Ø Porosity analysis is to measure mean pore size
- Ø Heat setting to remove solvent from the material
- Ø DSC and FESEM analysis of heat treated material
- Ø Hemocompatibility analysis is to check compatibility of material contact with the blood component

DEVELOPMENT OF SELF ASSEMBLED PEPTIDE HYDROGEL BASED BIOACTIVE DRESSING MATERIAL FOR CHRONIC WOUNDS
(Department of Science and Technology).

Chronic wounds cause substantial morbidity and economic burden as it exhibits challenging clinical problems with limited treatment modalities. More than 90 % of the chronic wounds fall under diabetic, venous and pressure ulcers. Tissue defects of such chronic wounds are repaired generally by using drastic operative interventions like amputations, free flaps and growth factors. These growth factors, in most cases are delivered topically using dressing materials like hydrogel, collagen film, alginate and polyurethane to the wound site. Since most of the growth factors have short half-life, there is a limitation in the bioavailability. As a result, patients often need multiple dressings to achieve a clinically beneficial effect. This requires the use of large quantities of growth factors making these wound healing therapies expensive. Hence it is planned to explore the possibility of self assembled peptides (SAP) to deliver growth factor in a slow and sustained manner.

DEVELOPMENT OF COLLAGEN COATED ON HERNIA MESH
(Sponsored by the Ministry of Textiles, Govt. of India, New Delhi).

Objective: To develop the biologically active mesh by coating collagens on the hernia meshes and test the mesh for biocompatibility.

Summary of Progress:

- ♦ Literature survey pertaining to the project has been completed.
- ♦ Standards required for the study were identified.
- ♦ Purchased and studied the characteristic features of the commercially available coated hernia meshes.
- ♦ Raw materials required for the study were procured and initial trials for coating collagen on the meshes have been conducted.
- ♦ Based on the preliminary observations, coatings have been improved and further trials were conducted.

DEVELOPMENT OF MOPPING PAD USING NONWOVEN AND WOVEN STRUCTURE
(Sponsored by the Ministry of Textiles, Govt. of India, New Delhi).

Objective: To develop the mopping pad using different combination, woven and nonwoven structure and to find best combination suitable for mopping pad application.

Summary of Progress:

- ♦ Literature survey pertaining to the project has been completed.
- ♦ Standards required for the study were identified.
- ♦ Purchased and studied the characteristic features of the commercially available mopping pad.
- ♦ Raw materials required for the study were procured and initial trials conducted for developing different structures of mopping pads.

ISOLATION AND IDENTIFICATION OF WOUND BED MICROORGANISMS
(In- house project)

Aim: To compare the antimicrobial efficacy of commercially available wound dressing materials against wound bed microorganisms.

Objective:

- To screen acute and chronic wound patients for infection and record their clinical histories through questionnaire.
- To measure the physical characteristics of wounds.
- To isolate and characterize the pathogens biochemically.
- To compare antimicrobial efficacy of commercially available wound dressing materials.

Summary of Progress

- A total of 350 cases were screened for acute and chronic wounds with infection and 33 were clinically suspected to be infected.
- 30 of the 33 cases were culture positive and considered definite cases of infection.
- Among the Gram stained direct smear of 33 samples, 30 yielded growth on culture which included polymicrobial (20 in total) and monomicrobial (10 in total) isolates.
- 27 patients' samples were negative to Gram stain and 3 were positive to Gram stain.
- Staphylococcus aureus and Bacillus subtilus were found to be the most common organisms.
- Antimicrobial susceptibility of antibiotic [gentamicin (G, 10 mg/ml), positive control] and various dressing materials such as Paraffin gauze (PG) (negative control), Bactigauze (BG), Ceptigras (CG) and Acticoat (AC) against the selected samples were found to be in the order of G>BG>CG>AC. The activity of AC was negligible when compared to other antimicrobial agents.
- With the preliminary results, the study is progressing further with the evaluation of above mentioned dressing materials against diabetes patients wound microorganism.

INSTRUMENTATION

DESIGN AND DEVELOPMENT OF AN AUTOMATED EQUIPMENT TO PRODUCE KNOTLESS INCISION CLOSURES
(Sponsored by the Ministry of Textiles, Government of India, New Delhi)

Surgical sutures are the most frequently used biomaterial for wound closure and tissue approximation. However, they rely on the surgeon's ability to tie secured knots, which is a challenging and time consuming process. Improper tieing and handling can result in knot breakage, and potentially wound dehiscence. Further, the knot impedes wound healing, constricts blood flow, distorts tissue, and increase scar formation. To overcome these problems, attempts have been made in developed countries to design self-anchoring sutures.

SITRA has earlier developed barbed sutures using micro – machining technique. However, to produce barbed, bi directional surgical sutures on a commercial scale, an automated machine with a larger production capacity needs to be fabricated.

The present project is for the fabrication of an automated high production equipment to produce knotless sutures.

The schematic diagram of the automatic equipment being developed by SITRA is shown in Figure 22.

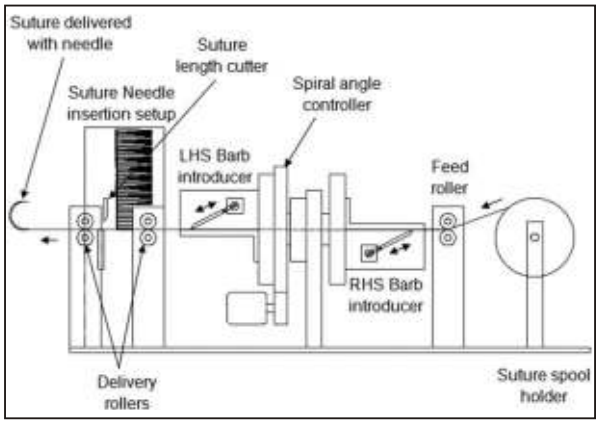


Figure 22 Schematic diagram of SITRA's Knotless Suture Manufacturing Machine (SKSMM)

Equipment working procedure:

1. The suture is inserted into the equipment through the feed roller.

2. The suture is joined with a needle in the "Suture Needle insertion set – up". This is to keep the sutures in a straight configuration during the introduction of barbs into the sutures.

3. Right hand side barbs are introduced into the suture when it is passed through the RHS barb introducer. In the same manner, left hand side barbs are introduced when the thread under question passes through LHS barb introducer. RHS and LHS barb introducers control the cut angle of the barbs introduced.

4. The spiral angle controller monitors the angle between two successive barbs.

5. The distance between the successive barbs is controlled by a servo motor connected with the delivery rollers.

6. The required length of suture material with barbs is cut using a suture length cutter and delivered.

7. These materials are then wound on suitable containers and marketed.

Performance evaluation of the equipment is in progress.

DESIGN AND FABRICATION OF AN INSTRUMENT TO ASSESS THE RESISTANCE OF MATERIALS USED IN MEDICAL FACE MASKS TO PENETRATION AGAINST AEROSOL PARTICLES

(Sponsored by the Ministry of Textiles, Govt. of India, New Delhi)

The main objectives of the project are:

— To develop a low cost instrument to assess the filtration efficiency of surgical face masks.

and

— To standardize the test procedures to be adopted for quality evaluation of surgical face masks made out of non – woven materials.

A surgical face mask also known as a procedure mask, is intended to be worn by health professionals during surgery and at other times to catch the bacteria shed in liquid droplets and aerosols from the wearer's mouth and nose. Normal activities such as sneezing, coughing, breathing and speaking may release oral, dermal and nasopharyngeal bacteria that may cause post – operative infections. Other types of aerosols include dental aerosols, laser plumes etc which are released during operation/other procedures.

Micro organisms have characteristics that can influence their ability to penetrate through the surgical facemask materials. As per studies conducted, different varieties of pathogens like Escherchia coli, Pseudomonas aeruginosa, Enterococcus faecalis, Candida abicans, Staphylococcus aureus etc are encountered in hospital environment and they cause infections.

Hence, a testing instrument to assess the filtration efficiency of surgical face masks against the micro organisms (mentioned above) is very essential for hospitals. At present no testing instrument is available indigenously and imported instruments are cost prohibitive. The present project has been carried out to develop one such instrument.

Design and Fabrication of a Particle Filtration Efficiency Tester

SITRA has designed and fabricated a particle filtration efficiency tester using the following principles.

i) Measurement of particle filtration efficiency of materials used in medical face masks using monodispersed aerosols.

ii) Measuring the filtration efficiency by comparing the particle count in the feed stream to that in the filtrate (downstream)

iii) Measuring the resistance of air flow through the medical face masks in terms of pressure drop.

SITRA's particle filtration efficiency tester (SPFET) is shown in Figure 23.

A series of filters namely 40, 1 and 0.1 micron filters are connected to compressor air outlet. The output of the 0.1 micron filter is connected to the cotton fibre air filter and bacteria membrane filter. The outlet of the bacteria membrane filter is connected to pressure regulator that is used to maintain the air flow of 1 CFM (Cubic Foot per Minute). The pressure regulator has two outlets. One outlet is connected to humidifier that is used to maintain the relative humidity of the testing instrument. Another outlet is connected to aerosol generator. Aerosol

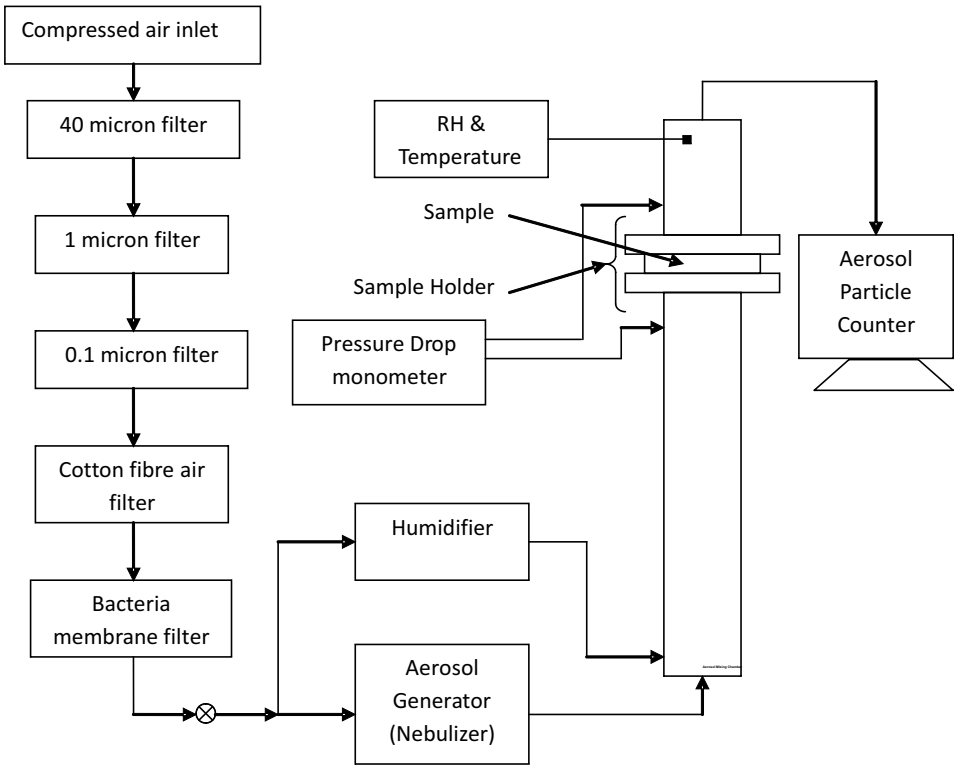


Figure 23 Line diagram of Particle Filtration Efficiency Tester developed by SITRA

generator is used to convert the liquid latex spheres into mists containing the mixture of air and latex spheres. The aerosol mixing chamber has two inlets and one outlet. One inlet is connected to the outlet of the nebulizer and another inlet is connected to the humidifier outlet. The aerosol mixing chamber is equipped with sample holder that is used to fix the sample. A pressure drop monometer is connected to aerosol mixing chamber. The pressure drop monometer has two inlets. One is connected to upstream (connected between aerosol generator and sample holder) and another one is connected to downstream (connected between sample holder and particle counter). The outlet of aerosol mixing chamber is connected to a particle counter. The particle counter is used to count the number of aerosol particles present in the supplied air. The particle counter has an inbuilt filter that is used to filter the aerosol air before the same is let out into the atmosphere.

The instrument works as per ASTM Designation F 2299 – 03. The working procedure is given below:-

After fixing a sample in the sample holder, the compressor air is allowed to pass through the series of filter. The filtered air is then passed to the two ways. One is passed to the aerosol generator and another one is passed through the humidifier. Humidifier is used to maintain the R_H range from 30 to 50% and hold the $R_H \pm 5\%$ during a test. When the aerosol mixing chamber R_H is less than 30%, the humidifier operates and supplies the humidified air to the aerosol mixing chamber. When the aerosol mixing chamber R_H is greater than 50%, the humidifier shut off and don't supply the humidified air to the aerosol mixing chamber. Likewise the R_H of the aerosol mixing chamber is maintained. The R_H maintained aerosol is then passed through the sample present in the sample holder. The aerosol filtered by sample is then passed to the particle counter which is used to count the number of aerosol present in the filtered aerosol. At the end of the aerosol mixing chamber R_H and a temperature sensor is placed to control the R_H of the aerosol mixing chamber. The particle counter counts the number of aerosol present in the supplied air filtered through the sample for 1 min. Apart from counting the number of aerosol, the pressure difference between upstream and downstream of the air is also measured. Upstream pressure is measured in between the aerosol generator and sample holder. Downstream pressure is measured in between the sample holder and the particle counter.

By using the following formula the filtration efficiency of the sample is calculated.

$$\text{Filtration efficiency (\%)} = \frac{\text{Number of aerosol particles present without sample} - \text{Number of aerosol particles present with sample}}{\text{Number of aerosol particles present without sample}} \times 100$$

Materials used for producing the Aerosol

Aerosol is a suspension of liquid or solid particles in air with the particles being in the colloidal size range.

It is not possible to use actual aerosol containing bacteria, due to possible risks of infection to operator, in the process of development of the proposed instrument. Hence, the monodisperse polystyrene spheres with equivalent size to bacteria were used as an aerosol in the whole experimentation.

The method of preparation of aerosol is as follows:

Monodisperse polystyrene spheres were synthesized by emulsion polymerization. It was produced using potassium per sulphate, sodium lauryl sulphate, styrene and aqueous carbinol.

50 ml of good quality distilled water is taken on a screw cap bottle. The 20 ml of carbinol is added with the distilled water and then 0.1 g of potassium per sulphate and 0.11 g of sodium lauryl sulphate are added with the carbinol mixed distilled water. Finally styrene with quantity of 3.5 g is added with the mixer and the same is kept at 70˚C with moderate stirring.

Inter – Laboratory Comparison of test results on resistance of fabric specimens to penetration against aerosol particles

4 different types of nonwoven medical face masks were used in the process of calibration of the instrument that was fabricated in this project. The details of the fabric samples are as follows.

i) 3 layer nonwoven medical face masks
ii) Mist respirator
iii) Particulate respirator for dust and water based mists and
iv) N95 particulate respirator.

The same face masks were tested in a foreign laboratory* equipment also for particle filtration efficiency. The results are given in Table 50.

Table 50 Comparison of test results obtained from SPFET and a foreign laboratory instrument

S.No	Type of surgical face masks	Results obtained from SPFET			Results obtained from a foreign laboratory instrument		
		Number of aerosol particles		Filtration efficiency (%)	Number of aerosol particles		Filtration efficiency (%)
		Without sample	With sample		Without sample	With sample	
1)	3 layer nonwoven medical face masks	13025	2531	80.57	10833	1913	82.34
2)	Mist respirator	15810	137	99.13	12555	102	99.19
3)	Particulate respirator for dust and water based mists	12579	65	99.48	11484	61	99.47
4)	N95 particulate respirator	14327	1	99.99	12634	1	99.99

It is discernible from the table that for all the surgical face mask specimens taken for experimentation, the results obtained from SPFET more or less matches with that obtained from the foreign laboratory equipment. Hence, SPFET can be conveniently used for evaluating the particle filtration efficiency of surgical face masks and other types of fabrics.

The project has been completed and a terminal report highlighting the major findings of the study has already been submitted to Ministry of Textiles.

** An accredited laboratory in the USA which regularly tests and certifies fabrics for their protection properties*

TRANSFER OF TECHNOLOGY AND RESEARCH UTILISATION

SERVICES TO MILLS

As in the previous years, the range of services offered by SITRA continued to be effectively utilised by the mills this year as well. The services availed by the mills during 2013 - 14 are given in Table 51.

Table 51 SITRA's services availed by the textile mills during 2013 - 14

Type of service	No. of units
Fibre, yarn and fabric testing	160*
Consultancy services	48
CPQ study and Online survey on RMC & YSP	242
Training: executives, supervisors and operatives	165
Accessories testing & instrument calibration	455

** Besides, over 1,826 small textile units also availed this service*

Testing of fibres, yarn and fabric was the most preferred service during the year (Table 52). The number of samples tested during the year (61,041) registered a substantial, 10.5% increase as compared to the number of samples tested during the previous year (55,176).

"Costs, Operational Performance and Yarn Quality" study (CPQ) covering key areas of a mill's functioning, initiated by SITRA 17 years ago, has been receiving good appreciation from mills. During the year 2013 - 14, 123 units availed this service.

During 2013 - 14, SITRA had initiated a new monthly online survey of raw material cost and yarn selling price in which as many as 119 mills had participated.

The training programmes offered for the managerial, supervisory and operative personnel were utilised by 165 units. Further details regarding the training programmes are given in the section under 'Training and Development Programmes'.

Major consultancy assignments handled by SITRA during the year, are listed below.

- Machinery valuation
- Estimation of conversion cost
- Benchmarking study
- Manpower and productivity improvement
- Functioning of a textile unit in Chad, Africa
- Measures to reduce invisible loss
- Technical study of spinning mills
- Quality improvement
- Energy audit
- Study of water consumption and / or material to liquor ratio of dyeing machines
- Technical study – Study of input / output norms for the consumption of Flame Retardant Chemicals used in the production of protective garments
- Measures to be taken while processing food grade fabrics free from Alkyl Phenyl Ethyl Oxylates (APEO)

Details of the individual consultancy services that were offered to the mills are presented in Annexure V.

COMPUTER AIDED TEXTILE DESIGN CENTRES

The first Computer Aided Textile Design Centre (CAD), established at SITRA, Coimbatore in 1995, received good appreciation from the industry.

Table 52 Testing services offered by SITRA during 2013 - 14

Type	Commercial		Project and Others	
	Samples	Tests	Samples	Tests
Fibres	31025	95331	1029	1554
Yarns	17302	33835	1335	1883
Fabrics	9239	12556	1111	1605
Total	57566	141722	3475	5042

Realising its importance, SITRA established 3 more centres, as a part of the PSCs. All the 4 centres have been functioning under SITRA's control without any financial assistance from the Ministry. The CAD system facilitates the creation of numerous designs quickly which can be varied or changed instantly depending upon the requirement of the customers. Computerised card punching, an intermediate technology, which will reduce the cost in both handloom and powerloom sectors, is also offered by the CAD centres. Table 53 shows the various services of these centres utilised by the decentralised weaving sector.

Table 53 Services offered by the CAD centres during 2013 - 14

S. No.	Type of service	No. of services
1.	Designs development /graph printouts	910
2.	Card punching	735
3.	Training programmes (persons trained)	11 (70)

POWERLOOM SERVICE CENTRES

SITRA had established its first centre at Somanur, Tamil Nadu three decades ago to cater to the needs of the decentralised sector. Since then, centres were set up at various places of powerloom concentration. At present, there are 7 centres, all of which are sponsored by the Ministry of Textiles, Government of India. The centres are located in Tamil Nadu at Karur, Komarapalayam, Palladam, Rajapalayam, Salem, Somanur and Tiruchengode. SITRA also operates a textile service centre at Chennimalai for the benefit of both handloom and powerloom units in that region.

The PSCs (Powerloom Service Centres) had conducted a number of interactive sessions with powerloom entrepreneurs under the TUF scheme. Various consultancy services like National consumer's awareness day programme, seminar on technical textiles, cluster development programme, machinery buyer-seller meet, entrepreneur development programmes, etc., were offered during the year. The year witnessed many machinery inspections being carried out under the credit linked capital subsidy scheme. Other services that were offered by the centres, like new project report preparation, machinery valuation, techno-economic viability study, project appraisal, textile extension study tour etc. also witnessed good response from the powerloom units.

Many rapier looms were installed in Coimbatore, Erode, Namakkal and Salem districts and these units have immensely benefitted from the various services and consultancies offered by the centres. Many of the shuttleless looms factory owners were supplying huge volume of fabrics for the orders received through buyer-seller meet and for meeting the ever green demand for Indian poplin and cambric fabrics.

Efforts taken by the SITRA powerloom service centres to implement the welfare schemes, under the Group Insurance scheme of Government of India,have benefited about 20,600 workers engaged in weaving, twisting, warping and sizing units. Most of the training programmes were conducted under the Integrated Skill Development Scheme (ISDS) of Ministry of Textiles, Government of India (Table 54).

Table 54 Training programmes conducted under the Integrated Skill Development Scheme (ISDS) (2013 - 14)

Course name	No. of persons
Fitter	8
EDP	22
CAD	23
Sewing machine operator	84
Embroidery	35
Total	172

The various services rendered by these powerloom service centres are given in Table 55.

Table 55 Services rendered by the powerloom service centres and SITRA textile service centre (2013 - 14)

S. No.	Type of service	No. of services
1.	Consultations	542
2.	New designs development	609
3.	Yarn / cloth / chemical samples testing	31,450
4.	Training programmes	91
5.	No. of persons trained	1056
6.	Liaison / request visits	2,639
7.	Number of looms inspected	27,042
8.	Number of special works	138*

** Seminars / Tuf / Meetings / Talks*

SITRA TEXTILE TESTING AND SERVICE CENTRE, TIRUPUR

A sample collection centre has been funtioning at Tirupur since 2005, towards fulfilling the requests from the knitting industry, textile processing units, export houses etc. in the region. Samples collected at the centre are brought to SITRA the same day. In many cases, results are reported to the customers within 24 hours, thus reducing considerably the turn around time. Based on customers' feedback, SITRA has upgraded the centre into an extension service centre and has completed the process of setting up a laboratory with essential instruments for testing of knitted fabric / garments. During the year, the centre had tested 1,404 samples with as many as 1,911 tests.

SERVICES RENDERED BY THE KNITTING DIVISION

The export of knit garments by various countries has led to a stiff competition among the exporting nations. The intense competition has forced the garment manufacturers to produce high quality garments at competitive prices. The production of quality garment with best prices requires great technical skill in purchasing the raw materials and control of the knitting, processing and finishing parameters. The necessity to produce a quality garment has initiated the need to test the various physical parameters of raw materials. The increase in the knit garment export has encouraged the spinning mills to enter into hosiery yarn production. Unlike the yarn intended for weaving, the hosiery yarn requires high quality, since the yarn imperfections will be clearly visible in weft knitted fabrics too. Hence, the production of quality hosiery yarns requires best raw material and hi-tech machines with proper process parameters. In the meantime, the competition prevailing in the spinning industry has forced them to produce quality hosiery yarns at competitive price. To achieve this, the spinning industry is conducting several trials to produce quality hosiery yarns at the minimum cost, to earn maximum profit.

The best method to evaluate the hosiery yarns' performance, is to knit the samples in the knitting machines. Keeping this in mind, SITRA is undertaking a lot of knitting trials and suitably advising the spinning mills to produce the required quality yarns. Apart from the above service, the knitting division is rendering several other important services like testing the knitted fabric, technical consultations, identification of the causes for the defects, sample development, machinery valuation etc., In addition to the above, the knitting department is conducting seminars focusing on the latest trends in the knitting industry and providing training at various levels. The following services were offered during 2013 - 14.

- Testing of various quality parameters of knitted fabrics and garments
- Fabric faults and their causes
- Assessment of the quality of hosiery yarns
- Offering consultancy services
- Conducting training programmes

The various services offered by the division in the year under review are given in Table 56.

The major testing services that were offered by the department include yarn count (228), fabric ends per inch and picks per Inch (90), weight per unit area (123), fabric shrinkage % (133), hank to cop conversion (63), twists per inch (58), course and

wales per Inch (23), sewability (7), course length / loop length (18), spirality % (32) and others (92).

Table 56 Services offered by the knitting division (2013 - 14)

S. No.	Type of service	No. of services
1.	Testing	867
2.	Defect analysis	1,141
3.	Samples knitting on FAK machine	1,746
4.	Knitting performance of yarn	299
5.	Consultation	327
6.	Training programmes (persons trained)	2 (62)

Like in the previous years, testing services continued to receive good response from the mills. Karl Mayer warp knitting and warping machines are available for samples development as well as medical textiles product development.

SITRA WEAVING CENTRE

SITRA's weaving centre is fully equipped with different types of shuttleless weaving machines like, Sulzer Projectile P700 HP, Picanol GTX Plus Rapier, Toyota JAT 710 Air-jet and Dornier LWV 4/E Air-jet machines to provide the following services to the textile industry to meet the global competition.

> Conducting weavers' training and maintenance training programmes in shuttleless weaving machines

> Entrepreneur Development Programme for new entrepreneurs to start weaving units.

> Preparation of project proposals, model project reports and technical feasibility study reports for weaving units under Technology Upgradation Fund (TUF) scheme.

> Conducting in-house training programmes for weaving units

> Consultancy services and liaison visits

> Product development and sample weaving

> Yarn performance study in shuttleless weaving machines

> Woven fabric defect analysis

> Training programme on fabric quality inspection and cloth analysis

> Management development programmes for sizing units

> Supervisory development programmes

Six BC, MBC and DNC candidates skill development training programme (61 fitters), 4 weavers training programmes under ISDS (90 weavers), 1 in-house weaver training programme for a mill at Andhra Pradesh (16 weavers) and 1 entrepreneur development programme (5 entrepreneurs) were conducted. The weaving centre had also conducted weft yarn performance study (6), fabricated viscosity cup (8) and offered 2 consultancy studies.

SITRA CALIBRATION COTTONS

With the quality management systems like ISO and TQM being implemented in many mills, checking of accuracy or calibration of the testing instruments has become mandatory for the textile mills. SITRA calibration cottons have been extensively used by the mills for many years. The calibration cotton marked LL3, SL3, LM3 & HM3 are being popularly used by the mills. During the year 2013-14, a total of 399 packets of these cottons were supplied to mills in different parts of India.

TEXTILE ACCESSORIES TESTING

SITRA offers testing service to evaluate the quality of spinning and weaving accessories / spares as per BIS standards. Moreover, training is imparted to the mill technicians on aspects like evaluation of quality characteristics, sampling procedures, etc. A total of 1,447 samples covering various accessories like carton boxes, paper cones, rings and travellers, tubes, kraft papers, ring spinning spindles, paper cores, fibre composite board, aluminium foil sheet, etc., were tested during the year under review (Table 57).

Table 57 Textile accessories testing (2013 - 14)

S. No.	Particulars	No.of samples
1.	Carton boxes	386
2.	Paper cones	837
3.	Tubes	84
4.	Rings & travellers	98
6.	Kraft papers	19
7.	Cots	2
8.	Spinning spindle	3
9.	Partition pad	1
10.	Worm & Worm gear wheel	2

CALIBRATION AND PERFORMANCE CERTIFICATION FOR INSTRUMENTS

Calibrating testing equipment and maintaining their reports is a requirement as per quality systems like ISO and TQM. Many mills are seeking SITRA's help to get a "Calibration Certificate" for their textile testing and quality control instruments. SITRA's certificates are rated as equivalent to the national standards of the National Physical Laboratory, New Delhi. During the year under review, 73 mills including weaving & knitting units availed the service of SITRA to receive calibration certificates for 379 textile testing and quality control instruments. Testing the performance of instruments developed by SITRA and manufactured by its licensees is another important service rendered for many years. During the year, 6 instruments were thoroughly checked for their performance and certificates were issued.

SITRA JUTE PROMOTION CENTRE

As in the case of earlier years, fine denier jute fibres (JRC 321) were grown by SITRA this year also with appropriate supervision. Certified seeds of JRC 321, amounting to 350 kg, were procured from Central Seed Research Station for Jute and Allied Fibres, West Bengal and the same were distributed to 116 farmers.

SITRA MICROBIOLOGY LABORATORY

Towards providing diversified services under chemical testing, in the year 2009 SITRA had started the microbiology testing facilities as an extension of its chemistry laboratory. The microbiology laboratory is well equipped to test the samples. The test facilities are listed below:

S.no.	Test applied	International Standard	Description
1.	Bacterial filtration efficiency	ASTM F 2101	Evaluation of the Bacterial filtration efficiency (BFE) of medical textiles using *Staphylococcus aureus* as challenging aerosol.
2.	Antibacterial Activity assessment of textile materials : Parallel streak method	AATCC 147 (Qualitative)	To determine antibacterial activity of diffusible antimicrobial agents on treated textile materials.
3.	Antibacterial Finishes on textile materials: Assessment of	AATCC 100 (Quantitative)	Evaluation of the degree of antibacterial finishes on textile materials.
4.	Testing for antibacterial activity and efficacy on textile products	JIS L 1902 : 2008 (Quantitative)	To evaluate the antibacterial efficacy of antibacterial finished textile products.
5.	Antifungal activity, assessment on textile materials: Mildew and rot resistance of textile materials	AATCC 30 Part 1 (Soil burial test)	To determine the susceptibility of textile materials to mildew and rot and to evaluate the efficacy of fungicides on textile materials.
		AATCC 30 Part 3 (Agar plate method)	To evaluate the susceptibility of textile specimen against fungal sp like *Aspergillus niger*

S.no.	Test applied	International Standard	Description
6.	Antimicrobial activity assessment of carpets	AATCC 174 Part 1 (Antibacterial activity qualitative) AATCC 174 Part 2 (Antibacterial activity quantitative) AATCC 174 Part 3 (Antifungal activity qualitative)	To determine the antimicrobial activity of new carpet materials and the effect of a cleaning process on the antimicrobial resistance of carpets.
7.	Determining the antimicrobial activity of immobilized antimicrobial agents under dynamic contact conditions	ASTM E-2149 (Quantitative)	To evaluate the antimicrobial activity of non-leaching antimicrobial treated specimen under dynamic contact conditions.
8.	Antimicrobial susceptibility tests.	In-house (Kirby Bauer method)	To determine the sensitivity or resistance of pathogenic aerobic and facultative anaerobic bacteria to various antimicrobial compound impregnated textile materials in order to identify its effectiveness against test organisms.
9.	Methods of sampling and microbiological examination of water	IS 1622-1981 MPN (Most probable number technique)	To measure the viable aerobic and facultative anaerobic bacteria in a water environment capable of growth on the selected plating medium.
10.	Heterotrophic plate count	APHA 9215 A,B (Pour plate method)	To estimate the number of live heterotrophic bacteria in water and measuring changes during water treatment and distribution.
11.	ETO Sterilization	In-house	To sterilize medical and pharmaceutical products which cannot support conventional high temperature steam sterilization.
12.	Resistance of materials used in protective clothing to penetration by blood-borne pathogens using Phi X174 bacteriophage penetration as a test system	ASTM F 1671-07	To measure the resistance of materials used in protective clothing to penetration by blood borne pathogens using phi x 174 phage virus.
13	Textile fabrics -Determination of antibacterial activity - Agar diffusion plate test	EN ISO 20645:2004 (Qualitative)	To determine the effect of antibacterial treatments applied to woven, knitted and other flat textiles.
14	Determining the activity of incorporated antimicrobial agent(s) in polymeric or hydrophobic materials	ASTM E 2180-07 (Quantitative)	Polymeric materials such as vinyl pool liners, shower curtains and various medical devices are treated frequently with incorporated or bound ant imicrobial agents. This test method is used to evaluate the antimicrobial effectiveness of agents incorporated or bound into or onto mainly flat hydrophobic or polymeric surfaces.

TRAINING SERVICES

1. STAFF TRAINING

Training of technical and managerial personnel from mills, apart from operatives, is an important activity of SITRA. Over the years, many mill technicians have been trained on various managerial and functional aspects of textiles. During the year 2013-14, 8 different training programmes were organised which included 3 functional programmes, 4 in-house and 1 international training. The details of the various programmes are given in Table 58.

A. Functional Programmes

SITRA's 34th Management Development Programme

The management development programme organised every year by SITRA, attracts young entrepreneurs interested in understanding the various aspects of textile mill management.

This intensive 2 months programme covers all the major aspects of mill management - material management, financial management and cost control, production and productivity, statistics and quality control, energy management,

Table 58 SITRA's training and development programmes (2013-14)

S. No.	Name of the programme	Duration (in days)	Category		
			A	B	C
	Functional programmes				
1.	Management development programme	60	1	7	7
2.	Entrepreneur development programme in "Shuttleless weaving machines"	7	1	5	5
3.	Programme on "Energy Management in Spinning Mills" at Tamilnadu Spinning Mills Association, Tirupur	1	1	53	53
	In-house programmes				
4.	Supervisory Development Programme	3	1	2	44
5.	"Textile for non-textile personnel" training programme	10	1	1	2
6.	Workshop on "Energy Management in spinning mills"	1	1	1	30
7.	Training Programme on "Yarn quality requirements for modern high speed weaving and knitting machines"	2	2	41	72
	International programme				
8.	SITRA's 62nd international training programme	60	1	16	32
	Total	-	8	125	245

Note :*A - Batches B - Orgnisations C - Participants*

maintenance, personnel management, etc. Seven young executives attended this programme which was held during October-December 2013.

Entrepreneur Development Programme in "Shuttleless weaving machines"

The programme was organised with the objective of educating young entrepreneurs on the technologies involved in weaving, case studies relating to woven fabric defects and remedial measures, TUF scheme, various sources of availing loans, the modalities involved in setting up new units etc. Five persons comprising of Managing Directors, senior executives and technical personnel attended the programme.

Training programme on "Energy management in textile mills"

In association with Tamilnadu Spinning Mills Association, SITRA organised a training programme on "Energy Management in textile mills" specially designed for the benefit of electrical engineers at Tirupur on 13th June 2013. Some of the topics that were covered during the programme included, energy consumption in various departments of spinning mills, consumption in ancillaries, specific energy consumption, auditing of energy resources, instruments involved in energy measurement, importance of energy conservation and measures to be carried out. A total of 53 electrical engineers attended the programme.

B. In-house Programmes

"Textile for non-textile personnel" training programme

At the request of a member mill at Arni, SITRA conducted, a ten day program for its executives. The focus of the programme was to sensitize the participants on the various technical aspects involved in spinning mills. Some of the topics covered were present scenario, work load and work assignment, waste reduction, quality improvement and weaving, non woven textiles, etc.

Workshop on "Energy management in spinning mills"

Under request from a leading spinning mill, SITRA organised a two-day workshop on "Energy Management in spinning mills" at Dindigul on July 5-6, 2013. Some of the topics that were covered during the programme included, energy consumption in various departments of spinning mills, consumption in ancillaries, specific energy consumption, auditing of energy resources, instruments involved in energy measurement, importance of energy conservation and measures to be carried out. A total of 30 persons attended the programme.

Training programme on "Yarn quality requirements for modern high speed weaving and knitting machines"

This programme was organized in the context of modern high speed weaving and knitting machines putting a lot of pressure on spinners to produce quality yarns that can withstand the increasing speeds. It has become imperative for spinners to dissect and understand the specific yarn quality requirements that are required to effectively run these yarns on different type of looms. The programme was held in two batches on 6th and 7th & 16th and 17th September 2013. A total of 72 persons from 41 mills participated.

Supervisory Development Programme

At the request of 2 member mills, SITRA conducted in-house supervisory development programmes at their mills during January & February, 2014. The programme covered technical topics like labour and machine productivity, yarn realisation and waste control, quality management in spinning, process control in spinning, energy conservation, TQM & maintenance practices to be followed and right work methods for operatives. The programme was well received by the participants, totaling 44.

C. International Training Programme

International training is a regular feature of SITRA's training activity since 1974. More than 1600 participants from 67 countries have so far been benefited out of SITRA's expertise in textiles. The participants taking part in such programmes are sponsored by the Ministries of External Affairs and Economic Affairs, Govt. of India, under their sponsoring schemes viz., ITEC (Indian Technical and Economic Co-operation Plan) and Colombo Plan.

The 62nd batch of this programme commenced on 7th October 2013. Two courses, Textile Mill

Management and Textile Testing & Quality Control, were offered. Thirty two participants from 16 countries – Afghanistan, Bangladesh, Botswana, Chile, Ethiopia, Eritrea, Ghana, Lithuania, Malaysia, Myanmar, Nigeria, Oman, Philippines, Sudan, Uzbekistan, and Zimbabwe attended the two-month programme.

The valedictory function of the programme was held on December 3, 2013. Dr. Prakash Vasudevan, Director, SITRA presided over the valedictory function and distributed course completion certificates to the participants.

2. Labour Training

SITRA has been regularly conducting training programmes for the textile mill workers for the past 32 years. As in the previous years, this year also many mills have utilized SITRA's services in this area. As many as 821 shop floor workers were trained. Training programmes were organized for operatives at mills' premises in the regional languages in 57 batches (Table 59).

Table 59 Training programmes offered for shop floor workers in 2013-14

S. No.	Type of programme	Number of		
		Mills	Batches	Partici-pants
1.	Operatives training	16	50	698
2.	Ancillary labour training	1	1	24
3.	Awareness programme	1	1	20
4.	Training of trainers	2	2	30
5.	Fitters training	1	3	49
	Total	21	57	821

(i) Pre-employment and retraining programmes

Pre-employment training for new entrants and retraining programmes for the experienced workers were conducted in 16 mills, covering 698 operatives in 50 batches. Significant improvement was achieved in key elemental timings, incidence of waste, production rate and quality of output in all the programmes. Details of the operatives training programmes for spinning mills conducted in 2013 - 14 are shown in Table 60.

Table 60 Break-up of operatives training programmes for spinning mills conducted in 2013-14

S. No.	Tenting jobs	Number of		
		Mills	Batches	Partici-pants
1.	Blow room / cards / draw frames / combers	1	1	10
2.	Fly frames	1	1	10
3.	Ring frames	9	36	501
4.	Open end spinning	1	2	34
5.	Cone winding	4	10	143
	Total	16	50	698

(ii) Ancillary labour training

Retraining programme was conducted for a member mill's doffers. They were trained to doff full cops and replenish empty cops using both the hands while doffing ring frames. Significant improvement was achieved in doffing time and controlling double gaiting.

(iii) Awareness programme

One spinning mill in Kerala availed SITRA's services for imparting training to its trainers towards creating an awareness of the importance of higher production, better quality, lower waste, proper planning, right work methods etc. The programme was intended to sensitise the trainers to effectively discharge their role and functions and achieve improvement in the mill's working. A total of 20 trainers attended the programme.

(iv) Programme on "Training of trainers"

Under a request from two member mills, one each in Tamilnadu and Kerala, a three day "Training of trainers programme" was organized. The aim of the programme was to sensitize them to effectively discharge their role and functions and achieve improvement in the mills' working. The topics covered included productivity, quality management, waste reduction, proper planning and scheduling of activities, methods of training, identification of training needs, training evaluation, right work methods to be followed and effective

communication and inter-personnel skills. A total of 30 trainers attended the programme.

(v) Fitters training programme

To upgrade the skills of fitters towards managing new technologies in shuttleless weaving machines, a fitters training programme was organised. Theoretical and hands-on practical training on the mechanism of hi-tech weaving machines and their maintenance were offered during the one month programme. Totally, 49 fitters were trained.

3. Skills Development Training Programmes Under SITRA – ISDS

The scheme aims to leverage on the strength of institutions such as SITRA, which has been imparting training to the personnel in the industry for more than 50 years and has trained close to 80,000 personnel so far. The strength of SITRA on this area is being utilized to cover many beneficiary groups in the coming years.

The year witnessed 1453 persons being trained under ten different programmes that were offered under this scheme (Table 61) and the completion of 10000 persons to be trained as envisaged under the scheme, within 3 years.

Table 61 Break-up of training programmes conducted under ISDS in 2013-14

S.No	Training details	Number of		
		Mills	Batches	Participants
1.	Spinning operatives training	25	55	1192
2.	Weaving operatives training	4	5	104
3.	EDP	2	2	26
4	Fitters training	1	1	8
5	CAD	2	2	23
6	Sewing machine operators training	2	2	42
7	Embroidery training	2	2	35
8.	Technical textile prog.	1	1	23
	Total	39	70	1453

APTITUDE TESTS FOR TEXTILE MILL OPERATIVES

Since the jobs in textile mills are mostly semi-skilled, repetitive and monotonous, it is of utmost important to select only those individuals who would have these characteristics and would desire to do these jobs. By doing so, mills can not only ensure more productivity but also greater commitment and involvement amongst the employees.

SITRA's aptitude tests are exclusively designed to meet the specific requirements of assessing the ability or aptitude of employees to do the expected activities in the various departments of a textile mill. These tests are being effectively used by around 200 member mills for the selection of employees and they are appreciative of the effectiveness of these tests. The tests measure whether an individual has the capacity or latent ability to learn and perform a given job if adequate training is provided. The use of aptitude tests is advisable for fresh applicants who have little or no experience and may be used by the mills interested in selecting employees for whom training will result in greater performance.

The tests are designed to cover the operatives for preparatory, spinning and weaving departments. Most of the jobs in these departments involve i) visual acuity eg., ability to note end breakages, ii) two hand coordination for working at machines eg., operations like piecing and knotting, iii) finger dexterity eg., operations like piecing and knotting iv) eye and hand coordination for operating the state-of-the-art machines and v) quick reaction time to respond to emergencies at the work place. All these psychophysical attributes are measured by using the three tests in the SITRA Aptitude Test Kit.

Since 2005, SITRA has included another sub-test to the Kit - colour blindness. Many times, it is observed that operatives suffering from colour blindness are unable to distinguish the subtle differences in colour variations as also identify the basic colour combinations. In order to ensure the best fit of operatives with the job, it is essential to screen out persons with this defect.

During the year 2013-14, 10 aptitude test kits were purchased by the textile mills.

MULTIMEDIA DVDS ON WORK METHODS FOR OPERATIVES

A new version of multimedia training materials, in DVD format, for the benefit of spinning mill operatives has been released by SITRA. Like the earlier version of VCDs released by SITRA, this DVD version also will serve as a handy tool for spinning mills to educate operatives on the right ways and means of working in spinning mills. All departments from mixing to reeling are covered. The highlight of the DVD is the option available to users to select any of the 5 languages voice-over

namely, Tamil, Telugu, Malayalam, Kannada and Hindi. An English version of the DVD is also available separately.

Departments covered: Mixing, blowroom, carding, combing, drawing, speedframe, ring spinning, open end spinning, manual cone winding, auto cone winding, ring doubling, two for one twisting and reeling.

During the year 2013-14, 10 DVDs were purchased by the textile mills.

CONFERENCES AND SEMINARS

International Medical Textile Expo and Conference 2014

SITRA organised a 3-day international textile expo cum conference – MEDITEX-2014 from 28th February to 2nd March, 2014. There was very good response to the Expo with participation of close to 60 exhibitors displaying various medical textile products / services. The Expo attracted quite a number of visitors of all the three days.

A conference held concurrently with the expo had 16 different seminars on key target areas where medical textile products are being used by various stakeholders like entrepreneurs, doctors, nurses, physiotherapists, purchase managers, housekeeping staff, traffic police officers, textile mill workers, lathe and foundry workers, IT professionals, sanitary workers, rural women, school girls, academicians, etc. The seminars were addressed by 61 different experts from industry / institutions. More than 2500 delegates attended the seminars which also witnessed 22 eminent persons gracing the seminars as Chief Guests.

Seminar on "ISO 50001:2011 Energy Management Systems (EnMS)"

Towards standerdising the systems involved in enerqy management, the International Organisation for Standardization (ISO) published the ISO 50001 energy management systems in June 2011. ISO 50001:2001 is a new systems standard which gives organisations the requirements for Energy Management Systems (EnMS). The system offers a systematic approach to monitor and reduce the energy consumption in all kinds of organisations. The systems is based on Plan-Do-Check-Act cycle, with requirements for establishing an energy policy with concrete objectives, putting in place actions to reduce and monitor energy use, verifying energy savings and planning improvements. It offers a comprehensive set of guidelines to achieve energy efficiency and energy saving which help in meeting carbon emissions requirements. It can be easily integrated to existing quality, safety and/or environmental management systems.

Some of the benefits to mills in implementing the system are, Reduced operating costs by controlling in-house energy consumption, Reduced greenhouse gas emissions, compliance with legislation by meeting current or future mandatory energy efficiency/ intensity targets, Enhanced corporate image and reputation among stakeholders and satisfied stakeholder and consumer expectations

In order to disseminate information on the ISO 50001 :2011 systems and its implementation benefits to industries, SITRA organised a one day awareness seminar on the above topic on 20th July 2013. A total of 93 technicians from textile and other industries took part in the Seminar.

A mini-exhibition, with displays of energy saving products / equipments / services by reputed companies, also formed part of the seminar.

COMMUNICATION

Library

SITRA library with its large collection of books and periodicals continued to attract many technicians from member mills as well as students from colleges and universities. During the year, more than 850 technicians, over 4,500 students and 150 outside specialists visited SITRA library for utilising its rich collection of books and journals. Two hundred and sixty five books and pamphlets have been added to the existing bank of more than 25,480 books. SITRA has also been receiving 125 journals on varied aspects in textiles and management.

Visitors

Three important dignitaries visited SITRA during the year, the details of which are given in Annexure II.

Publications

SITRA has brought out 28 publications during the year which included 16 research / inter-mill study reports, 6 focus and 6 SITRA news publication (Annexure III).

SITRA scientists published 19 papers in various technical journals and presented 9 papers in conferences and seminars (Annexure VI).

ANNEXURE I

THE STAFF

Director
Dr.Prakash Vasudevan. M.Sc. (Textile Engineering), Ph.D (Leeds)

SPINNING
General Manager (Projects) & Head of Division:
Dr.K.P.Chellamani, M.Tech., Ph.D., C.Engg., F.I.E., F.T.A.

Junior Scientific Officers:
M.K.Vittopa, M.Tech., A.M.I.E.
D.Veerasubramanian, M.Tech.
R.S.Vignesh Balaji, M.Tech.

WEAVING AND KNITTING
Assistant Director & Head of Division:
K.Balasubramaniyan, M.Tech.

Junior Scientific Officers:
S.Sounderraj, M.Tech.
P.Sundaramoorthy, M.Tech.

LIAISON AND CONSULTATION
Deputy Director & Head of Division :
D.Shanmuganandam, M.Tech., M.I.E.

Research Associate:
S.Mariappan, M.Tech.

Senior Scientific Officers:
J.Sreenivasan, M.Tech.
N.K.Nagarajan, B.Tech.
P.Subash, M.Tech.

TEXTILE ENGINEERING & INSTRUMENTATION
Head of Division:
M.Muthukumaran, B.E.

Senior Scientific Officer:
S.Sugumar, B.Sc., A.M.I.E., C.Engg., PGDCM, MCA.

Junior Scientific Officers:
M.Muthuvelan, B.E., PGDBA., M.B.A., M.Phil (Mgmt).
N.Vasanthakumar, B.Sc., A.T.I.
V.Kumaravel, B.E.

TEXTILE PHYSICS
Assistant Director & Head of Division:
S.Kadirvel, M.Tech.

Junior Scientific Officer:
R.Pasupathy, M.Tech., M.B.A., A.M.I.E.

TEXTILE CHEMISTRY
In-charge of Division :
S.Sivakumar, M.Tech.

TRAINING DIVISION
Research Associate and Head of Division:
Dr.K.Sajjan Rao, MA, M.Phil, Ph.D., PGDPM&IR, DIC.

ISDS / Powerloom Service Centre
Senior Scientific Officer:
M.P.S.Ravindran, B.Tech., M.B.A.

CENTRE OF EXCELLENCE FOR MEDICAL TEXTILES
Head of Division :
P.Sakthivel, B.Com., M.B.A., (D.H.Tech.)

Principal Research Investigator:
Dr. Ketan Kumar Vadodaria, M.Tech., Ph.D.

Senior Scientific Officers:
S.Thiruppathi, M.Tech.
Dr.E.Santhini, Ph.D.

Junior Scientific Officers:
T. Sureshram, M. Tech.
Thirumala Srinivasa Pitchika, B.A., MFM (NIFT)
S.P.Sivasubramanian, M.Text.
A.Neha, M.Text.

ADMINISTRATION
Administrative Officer:
R.Ravichandran, B.Com., A.C.S., Dip. Sec. Pract.

Head - Finance and Cost Accounts:
K.Vadivazhaki, B.Com., A.C.A.

Head - HR:
R.Sivaram, MHRM, M.B.A.

Research Associate:
R.Suganthi, M.Sc., M.C.A., M.C.S.D., Net 07,OCA & OCP.

Secretary to Director:
N.Saradha Jayalakshmi, M.Sc., M.B.A.,DISM, PGDSM, PGDMM.

Junior Officers:
V.Gopalakrishnan, M.A., M.L.I.S.
K.Prabha, M.Com., PGDCA

CONSULTANTS:
Cyril Lourdes, B.Com.
A.Sivaramakrishnan, M.Tech., C.Text., A.T.I., A.M.I.E.
A.Sankara Namasivayam, B.Tech.
R.Krishnan, M.E.
P.Arumugam, B.Sc.

Total staff strength as on 31st March 2014

Officers	***: 38***
Scientific/Technical assistants	***: 34***
Administrative staff	***: 10***
Skilled/Semi skilled & maintenance services	***: 30***
Technical assistants on contract	***: 9***
Total	***:.....121***

Textile Service Centre, Jute Promotion Centre and Textile Testing & Service Centre

Officer	***: 1***
Scientific/Technical assistants	***: 4***
Total	***:.....5***

Powerloom service centres (Govt. sponsored)

Officers	***: 2***
Scientific/Technical assistants	***: 31***
Technical assistants on contract	***: 1***
Skilled/Semi skilled	***: 7***
Total	***:.....41***

ANNEXURE II

VISITORS

Dr. Kavuru Sambasiva Rao, Hon'ble Union Minister of Textiles, Government of India.

Mr. A.B.Joshi, Textile Commissioner, MoT, GoI.

Ms. Sunaina Tomar, Joint Secretary, MoT, GoI.

Mr. Martin W. King, PhD, FITS, LTI, Professor of Biotextiles & Textile Technology, North Carolina State University, College of Textiles

Dr. Teli Mangesh.D, Professor & Former HOD, Dept. of Fibres and Textile Processing Techonolgy, Dean, SA & HRD, Institute of Chemical Technology, Mumbai.

ANNEXURE III

SITRA PUBLICATIONS DURING 2013 - 2014

1. Research / Inter-mill study reports :

How to estimate sort-wise yarn to grey woven fabric conversion cost correctly? – SITRA method - *S.Mariappan, K.Balasubramaniyan and D.Shanmuganandam*

Compact yarn manufacturing – a value addition - *D.Shanmuganandam*

Costs, operational performance and yarn quality: Inter-mill study of key factors (29th study) - *D.Shanmuganandam, J.Sreenivasan and I.Suresh Balu*

Online survey of RMC and YSP – 11 online reports (May 2013-March 2014) - *N.K. Nagarajan, P. Subash, S. Raj Kumar and D. Shanmuganandam*

A study on lubrication practices in ring frames – *D.Shanmuganandam, J.Sreenivasan and N.Parthassarathy*

An inter-mill study on fibre to yarn conversion cost - *J.Sreenivasan and D.Shanmuganandam*

2. Focus:

How to increase yarn realisation in OE spinning mills? – A case study - *J.Sreenivasan, I.Suresh Balu and D.Shanmuganandam*

Impact of inter-mill variation in the techno-commercial parameters on the financial performance of the spinning mills - *D.Shanmuganandam and N.K.Nagarajan*

How can a mill analyse its technical and commercial performance periodically? - *D.Shanmuganandam*

Hard waste control in automatic cone winding – an analysis - *D.Shanmuganandam and J.Sreenivasan*

How to monitor the commercial performance of a spinning mill? - *D.Shanmuganandam*

How to control invisible loss in spinning mills? – A case study 3 - *J.Sreenivasan and D.Shanmuganandam*

3. SITRA News:

Numbers 1 to 6

4. Other Publications:

Annual report 2012-13

ANNEXURE IV

SITRA DEVELOPMENTS

1. Machinery

Storage positive feed system for knitting machines
High speed reeling machine
High production cutting machine
High speed blending draw frame single delivery machine
"Spinfan" system for fancy yarns
SITRA - VOLKA ring frame
"Enerspin" drive system for ring spinning & doubling frames
SITRA "miniSPIN" - Miniature spinning plant for test runs
SITRA ENERCONER - Energy efficient drive control system for automatic cone winding machines
Energy and production information system for ring spinning frames "SITRA EnerInfosys"
SITRA ener TFO
SITRA CIM
SITRA Microcontrol
Weavability Tester
High performance jute flyer spinning frame - SITRA Jute Flyspin
Micro controller based energy saving & information system for air compressors used in textile mills - SITRA PCRA ENERCOMP

2. Fibre and Yarn Testing Instruments

Fibre bundle strength tester
Trash separator
Electronic twist tester
Electronic lea strength tester
Semi - Automatic twist tester
Motorised twist tester
Nep counter
SITRA motorised multi-board yarn appearance winder
Electronic load indicator for conventional lea strength tester (ELCONLEA)
SITRA rapid sample conditioner
SITRA- ABRATEST - Yarn abrasion resistance tester
Single yarn strength tester
Schnidt model yarn tension meter

3. Others

SITRAlised energy saving spindle tapes
SANTIMIT
Weft feeler mechanism to stop the loom for pirn changing
Energy efficient fans - SITRA excel fan
Infra colour dyeing machine
Shore hardness tester
Cyberscan bench top PH meter
Fabric stiffness tester
Drapemeter
Fabric thickness tester
MRG crimp tester
Fabric elongation tester
Fabric roughness/friction tester
UV Photocatalytic reactor
Self anchor suturing machine
CSP system and fabric strength tester
Fabric winding mechanism for powerlooms
Arterial prosthetic graft
SITRA pneuma kit
SITRA motor relay tester
Lab fabric dyeing machine
Soxhlet extraction mantles
Microprocessor based electronic balance
Launderometer
Crease recovery tester
Perspirometer
SITRA Enercool
Fabric compression tester
SITRA's Bacterial Filtration Efficiency Tester
SITRA's blood penetration resistance tester

SITRA may be contacted for the addresses of the Licensees

ANNEXURE V

LIST OF STUDIES / SERVICES RENDERED TO MILLS

Mills utilised SITRA's services and expertise for a wide range of their requirements. Some of the studies/services attended during 2013 - 14 were:

Machinery valuation (10), Fabrication of viscosity cup (8), Study of water consumption and / or material to liquor ratio of dyeing machines (8), Weft yarn performance study in shuttleless looms (6), Mandatory energy audits (4), Ukg study (4), Evaluation study in fluorescent tube light (4), Quality improvement (3), Study on compressed air system (3), Annual Consultancy Service (ACS) for humidification plants & compressors (3), Technical study (2), Study on humidification system (2),

Apart from the above, the following studies were also undertaken: Estimation of conversion cost, Bench marking study, Man power and productivity improvement, Functioning of a textile unit in Chad, Africa, Measures to reduce invisible loss, Weaving machinery valuation, Weaving consultancy, Comprehensive energy audits, Noise level study, Water consumption study of soft flow dyeing machine, Harmonic study, Air consumption study in autowinders, Valuation for processing machinery, Technical troubleshooting – Identification of measures to minimise formation of rubbery material in multiple effect evaporator, Troubleshooting of white patches problem on dark colour dyed fabrics, Shrinkage optimization study of pre-processed cotton/flax blended woven fabrics, Technical troubleshooting – selection of suitable process route to eliminate black dots formation on bleached fabrics, Technical study – study of input / output norms for the consumption of flame retardant chemicals used in the production of protective garments, Measures to be taken while processing food grade fabrics free from Alkyl Phenyl Ethyl Oxylates (APEO), Optimisation of process parameters to achieve level dyeing of 3/600 D multi-filament polyester yarn in cheese form using disperse dyes and Oeko-Tex certification.

In addition, more than 6,790 day-to-day problems on different areas were referred by the mills for SITRA's guidance and services. Prominent among them are designs development and card punching by CAD centres and PSC's (1,645), Defect analysis and fabric analysis (2,305), Assessment of knitting performance (299), New designs development (609), Textile accessories testing (1,447), Calibration of testing instruments (379), Performance certification issued to testing instruments (6) and more than 100 Adhoc problems dealt by the Spinning, Physics, Chemistry, Engineering and Training Divisions .

ANNEXURE VI

PAPERS PUBLISHED IN JOURNALS AND PAPERS PRESENTED IN CONFERENCES

PAPERS PUBLISHED

Prakash Vasudevan K.P.Chellamani	Technical Textiles: SITRA's Contributions	Texfair 2013 – Souvenir, SIMA, December 2013, pp. 28 – 45.
K.P.Chellamani, M.K.Vittopa R.S.Vignesh Balaji	Studies on a new fibre length tester towards process optimisation	Asian Textile Journal, January 2014, Volume 23, No.1, pp. 70 – 74.
K.P.Chellamani R.S.Vignesh Balaji	Medical textiles using nonwoven technology - Part II	SITRA E-Bulletin, April 2013, Volume 1, Issue 2.
K.P.Chellamani R.S.Vignesh Balaji J.Sudharsan	Chitosan treated textiles substrates for wound care applications	Journal of Academia and Industrial Research (JAIR), July 2013, Volume 1, Issue 2, pp. 97 - 102.
K.P.Chellamani R.S.Vignesh Balaji J.Sudharsan	Antibacterial properties of allopathic drug loaded polycaprolactone nanomembrane	Journal of Academia and Industrial Research (JAIR), November 2013, Vol.2, Issue 2, pp. 341 – 344.
K.P.Chellamani, R.S.Vignesh Balaji J.Sudharsan	Quantitative and qualitative requirements of cotton in the 12th Five year plan period	Journal of the textile association November - December 2013, Vol.74, No.3, pp. 140 – 149.
K.P.Chellamani D.Veerasubramaian R.S.Vignesh Balaji	Surgical sutures: an overview	Journal of Academia and Industrial Research (JAIR), May 2013, Volume 1, Issue 12, pp. 778 - 782.
K.P.Chellamani D.Veerasubramanian G.Panner Selvam	Thermal characteristics of hospital bed linens – a sensitive science	Journal of Academia and Industrial Research (JAIR), November 2013, Vol.2, Issue 2, pp. 374 – 377.
K.P.Chellamani, D.Veerasubramaian R.S.Vignesh Balaji	Medical textiles: the spunlace process and its application possibilities for hygiene textiles	Journal of Academia and Industrial Research (JAIR), May 2013, Volume 1, Issue 12, pp. 735 - 739.
K.P.Chellamani D.Veerasubramanian R.S.Vignesh Balaji	Surgical face masks: Manufacturing methods and classification	Journal of Academia and Industrial Research (JAIR), November 2013 Vol.2, Issue 2, pp. 320 –324
K.P.Chellamani D.Veerasubramanian R.S.Vignesh Balaji	Tensile and tearing strength of woven fabrics: some studies	Asian textile Journal, November 2013, Vol. 22, No. 11, pp. 70 – 74.
K.P.Chellamani J.Sudharsan J.Sathish	Medical textiles using braiding technology	Journal of Academia and Industrial Research (JAIR), June 2013, Volume 2, Issue 1, pp. 21 - 26.
D.Shanmuganandam	Mills periodic analysis of techno-commercial performance	Indian Textile Journal, December 2013, Volume 124, Issue 3, pp. 48 - 52.
D.Shanmuganandam	Compact yarn manufacturing – a value addition	Asian Textile Journal, February 2014, Volume 23, Issue 2, pp. 33 - 36.

ANNEXURE VI

PAPERS PUBLISHED IN JOURNALS AND PAPERS PRESENTED IN CONFERENCES (CONTD..)

D.Shanmuganandam J.Sreenivasan	Hard waste control in automatic cone winding	Indian Textile Journal, March 2014, Vol. 124, Issue 6, pp. 43 - 47.
D.Shanmuganandam N.K.Nagarajan	Impact of inter-mill variation in techno-commercial parameters on financial performance of spinning mills	Asian Textile Journal, October 2013, Volume 22, Issue 10, pp. 45 - 48.
D.Shanmuganandam, S.Rajesh kumar P.Subash	How to optimize manpower requirement in spinning mills?-a case study,	Spinning Textiles, Jan. - Feb. 2014, Volume 8, Issue 1, pp. 4 - 8.
S.Mariappan D.Shanmuganandam	Improving yarn quality towards reducing knitted fabric defects - a case study	Asian Textile Journal, April 2013, Volume 22, No. 4, pp. 64 - 66.
J.Srinivasan I.Suresh Balu D.Shanmuganandam	How to improve yarn realisation in OE spinning mills? - a case study	Indian Textile Journal, August 2013, Volume 123, Issue 11, pp. 23 - 28.
B.Renuka	Screening effect of flavonoids in Caralluma Nilagiriana using Chromatographic technique	International Journal of Pharmaceutical Research and Development (IJPRD), October 2013, Volume 5, Issue 8, pp. 1 - 6.

PAPERS PRESENTED

K.P.Chellamani	Scope of Medical Textiles in India	Conference held at Sona College of Technology, Salem held during 11th & 12th June 2013.
K.P.Chellamani	Current Areas of research in medial textiles at SITRA	Conference jointly organised by CII (Confederation of Indian Industry) and DSIR (Department of Scientific & Industrial Research, Govt. of India) held at Coimbatore on 13th August 2013
K.P.Chellamani	Antimicrobial meditech fabrics developed by SITRA	National level workshop on "Antimicrobial evaluation of medical textiles products" conducted at SITRA, Coimbatore on 12th December 2013.
K.P.Chellamani	Medical Instrumentation at SITRA	'Meditex-2014' exhibition cum conference conducted at SITRA, Coimbatore during 28th February – 2nd March, 2014.
N.Vasanthakumar	Energy efficiency in Spinning Mills	"Promotion of Grid Connection Solar Power Plant" organised by m/s. ITCOT Consultancy & Services Ltd., Chennai held at Hotel Rathna Residency, Coimbtore on 29th January, 2014.

ANNEXURE VI

PAPERS PUBLISHED IN JOURNALS AND PAPERS PRESENTED IN CONFERENCES (CONTD..)

TALKS GIVEN

K.P.Chellamani	Quality Management	Lakshmi Machine Works Limited, Coimbatore for young entrepreneurs on 24th September 2013.
K.P.Chellamani	Quality Management	Lakshmi Machine Works Limited (LMW), Coimbatore for entrepreneurs on 30th January, 2014.
K.P.Chellamani	Current Textile Scenario and the scope for Medical Textiles in India	Annual General Body Meeting (AGM) of Karnataka Textiles Mills Association (KTMA) at Bangalore on 28th March, 2014.
Sakthivel Perumalsamy	Introduction to Medical textiles & its application	KSR Polytechnic College, Tiruchengod on 13th August 2013.
Sakthivel Perumalsamy	Business opportunities in Medical Textiles	Kongu Arts & Science college, Erode on 19th September 2013
Sakthivel Perumalsamy	Emerging trends in Medical textiles	Kumaraguru College of Technology, Coimbatore on 21st September 2013.
Sakthivel Perumalsamy	Promising past, Prosperous future -Medical Textiles	"Messe Franfurt Techtextil 2013" held at Mumbai on 4thOctober 2013.
S.Sivakumar	Quality evaluation of dyed and finished textiles	TEQIP - II faculty development programme organised by P.S.G. College of Technology, Coimbatore on 6th July 2013.
T. Karthikeyan	Characterization of medical textile products	National convention of Textile Engineers at KSR College of Technology, Tiruchengode.
C. Vanithamani	Testing of technical textile products	National convention of Textile Engineers at KSR College of Technology, Tiruchengode.

ANNEXURE VII

MEMBERS OF COUNCIL OF ADMINISTRATION

Elected members

1. Mr. D.Krishnamurthy, Managing Director, Sri Kumaran Mills Limited, Coimbatore (Chairman).
2. Dr. K.V.Srinivasan, Managing Director, Premier Mills Pvt. Ltd., Coimbatore.(Vice-Chairman).
3. Mr. B.Gopinath, Technical Director, Sri Venkatalakshmi Spinners (P) Ltd., Udumalpet.
4. Dr. B.K.Krishnaraj Vanavarayar, Chairman, Sri Sakthi Textiles Ltd., Pollachi.
5. Mr. Sanjay Jayavarthanavelu, Chairman & Managing Director, Lakshmi Machine Works Ltd., Coimbatore.
6. Mr. D.Sarath Chandran, Chairman & Managing Director, Precot Meridian Ltd., Coimbatore
7. Mr. E.Sathyanarayana, Managing Director, Sree Sathyanarayana Spinning Mills Ltd., Tanuku.
8. Mr. J.Thulasidharan, Managing Director, The Rajaratna Mills Ltd., Coimbatore.
9. Mr. S.Venkat Kumar, Whole time Director, Selvaraja Mills P. Ltd., Coimbatore.

Permanent Members

10. The Managing Director, National Textile Corporation (TN&P) Ltd., Coimbatore.
11. The President, Madura Coats Pvt. Limited, Bengaluru.
12. The Wholetime Director, The Lakshmi Mills Co. Ltd., Coimbatore.

Directors of the Textile Research Associations of India

13. Dr. Prakash Vasudevan, Director, The South India Textile Research Association, Coimbatore.
14. Dr. A.K.Sharma, Director, The Ahmedabad Textile Industry's Research Association, Ahmedabad.
15. Dr. A.N.Desai, Director, The Bombay Textile Research Association, Mumbai.
16. Dr. Arindam Basu, Director General, Northern India Textile Research Association, Ghaziabad.

Representatives of the Ministry of Textiles, Government of India.

17. The Additional Secretary & Financial Adviser, Ministry of Textiles, Govt. of India, New Delhi.
18. The Joint Secretary, Ministry of Textiles, Govt. of India, New Delhi.
19. The Textile Commissioner, Office of the Textile Commissioner, Govt. of India, Mumbai.

Representatives of the Government of Tamil Nadu

20. The Commissioner of Handlooms and Textiles, Govt. of Tamil Nadu, Chennai.

The Tamil Nadu Handloom Weavers' Co-operative Society Ltd., Chennai.

21. The Managing Director, The Tamil Nadu Handloom Weavers' Co-operative Society Ltd., Chennai.

The Southern India Mills' Association

22. Chairman, The Southern India Mills' Association, Coimbatore.

Special invitees

23. The Director, Central Leather Research Institute, Chennai (CSIR representative).
24. The Director, Ministry of Textiles, Govt. of India, New Delhi.
25. The Chairman, Confederation of Indian Textile Industry, New Delhi.

ANNEXURE VIII

MEMBERS OF SUB-COMMITTEES

(A) Finance and machinery sub-committee

Mr.D.Krishnamurthy (Chairman)	Sri Kumaran Mills Limited, Coimbatore.
Dr. K.V.Srinivasan (Vice-Chairman)	Premier Mills Pvt. Ltd., Coimbatore.
Mr.E.Satyanarayana	Sree Satyanarayana Spinning Mills Ltd, Tanuku.
Dr. Prakash Vasudevan	Director, SITRA, Coimbatore.

(B) Staff and awards sub-committee

Mr.D.Krishnamurthy (Chairman)	Sri Kumaran Mills Limited, Coimbatore.
Dr. K.V.Srinivasan (Vice-Chairman)	Premier Mills Pvt. Ltd., Coimbatore.
Mr.Sanjay Jayavarthanavelu	Lakshmi Machine Works Ltd., Coimbatore.
Mr.J.Thulasidaran	The Rajaratna Mills Ltd., Palani.
Dr. Prakash Vasudevan	Director, SITRA, Coimbatore.

ANNEXURE IX

MEMBERS OF RESEARCH ADVISORY COMMITTEE

Members

1. Mr. D.Krishnamurthy, Sri Kumaran Mills Limited, Coimbatore. (Chairman)
2. Dr. K.V.Srinivasan, Premier Mills Private Limited, Coimbatore. (Vice Chairman)
3. Dr. Prakash Vasudevan, SITRA, Coimbatore. (Director)
4. Dr. Arindam Basu, Northern India Textile Research Association, Ghaziabad.
5. Mr. Christopher Karunakaran, Premier Fine Linens (P) Ltd., Pollachi.
6. Dr. A.N.Desai, The Bombay Textile Research Association, Mumbai.
7. Mr. S. Dinakaran, Sambandam Spinning Mills Ltd., Salem.
8. Mr. J. Harish Chandravel, Ram Narayana Mills Ltd., Coimbatore.
9. Mr. T. Kannan, Thiagarajar Mills Ltd., Kappalur.
10. Ms. N. Kothai, Sree Jeya Soundaram Textile Mills Private Ltd., Madagupatti.
11. Mr. B.K. Patodia, GTN Textiles Ltd., Aluva.
12. Dr. A.K. Rakshit, Reliance Industries Ltd., Mumbai.
13. Mr. Sanjay Jayavarthanavelu, Chairman cum Managing Director, Lakshmi Machine Works Limited, Coimbatore
14. Dr. A.K. Sharma, The Ahmedabad Textile Industry's Research Association, Ahmedabad.
15. Mr. N. Subramaniam, Habasit Iakoka, Coimbatore.
16. Mr. Sujit Gulathi, I.A.S., Joint Secretary, Ministry of Textiles, Government of India.
17. The Commissioner of Handlooms and Textiles, Govt. of Tamil Nadu, Chennai.
18. The Director, Central Leather Research Institute, Chennai.
19. The Chairman & Managing Director, National Textile Corporation (TN&P) Limited, Coimbatore.
20. The Textile Commissioner, Office of the Textile Commissioner, Mumbai.

Invitees

1. Dr.R. Alagirusamy, Professor, Indian Institute of Technology,New Delhi
2. Dr. V.R. Giridev, AC College of Technology, Chennai.
3. Mr. B. Gopinath, Sri Venatalakshmi Spinners Pvt. Ltd., Udumalpet.
4. Mr. Prashanth Chandran, Precot Meridian Ltd., Coimbatore.
5. Dr. T.Ramachandran, Karpagam Institute of Technology, Coimbatore.
6. Dr.A. Ramamoorthy, Medical Practitioner, Coimbatore.
7. Dr R. Rajkumar, Chief Medical Officer, Kovai Diagnostic Centre, Coimbatore
8. Mr. A.Shanmugavasan, Managing Director, KOB Medical Textile Pvt. Ltd., Palladam
9. Dr. J.Srinivasan, Kumaraguru College of Technology, Coimbatore.
10. Dr.J.Venkat Rao, Ex- Director General, NITRA, Ghaziabad.

ANNEXURE X

COMMITTEES IN WHICH SITRA STAFF REPRESENTED

Member,Sub-committee for manpower planning for the textile engineering industry constitued by India ITME Society, Mumbai.

Member, Project management committee for Mini Mission III and Mini Mission IV of Jute Technology Mission.

Supervisor, Ph.D & M.Phil. Programmes (Textile Technology), Anna University, Chennai.

Supervisor, Ph.D & M.Phil. Programmes (Textile Physics), Bharathiar University, Coimbatore.

Member, TX 0I Committee, Bureau of Indian Standards, New Delhi.

Member, TX 05 Committee, Bureau of Indian Standards, New Delhi.

Member, Panel of Expert for the Constitution of Selection/ Assessment Committees in Textile Technology, National Institute of Science Communication.

Member, Board of Studies of PSG College of Technology for TextileTechnology.

Chairman, Hosiery Sectional Committee, TX 10, Bureau of Indian Standards, New Delhi.

Member, Council of National Jute Board, Kolkata.

Member, All India Powerloom Board, Ministry of Textiles, Government of India, New Delhi.

Member, Advisory Committee & member, Staff Selection Board, Textile Technology Department, Kumaraguru College of Technology, Coimbatore.

Member, Council of Administration, SIMA Cotton Development & Research Association.

Member, Cotton Advisory Board, Ministry of Textiles, Govt. of India.

Member, CITI Cotton Development & Research Association, New Delhi.

Member, Board of Examiners of Indian Institute of Handloom Technology, Salem.

Member, CII, Southern Region, Textile Sub-committee.

Expert member, Board of studies in Textile Technology, Bannari Amman Institute of Technology (Autonomous), Sathyamangalam.

Member, Confederation of Indian Industries (CII), Coimbatore zone.

Member, Sardar Vallabhbhai Patel International School of Textiles and Management, Coimbatore.

Member, Cotton Selection/purchase committee, KVIC, Chitradurga.

Member, Technical Sectoral Expert Committee of Textile Sector under PAT Scheme of Bureau of Energy Efficiency (BEE)

ANNEXURE XI

SITRA MEMBER MILLS

Full Members

1 Adwaith Textiles Limited
2 Alagendra Textiles Limited
3 Amarjothi Spg. Mills Ltd.
4 Anna Co-op. Spg. Mills Ltd.
5 Annamalaiar Mills Private Ltd.
6 Anugraha Fashion Mill (P) Ltd
7 Arunkkumar Spg Mill Private Ltd *
8 Ashwin Industries (P) Ltd
9 Ashwinram Spinning Mills P Ltd
10 B K S Textiles Private Limited
11 B R T Spinnerrs Limited
12 Best Cotton Mills (P) Ltd
13 Cardwell Spinning Mills Limited
14 Chenniappa Yarn Spinners (P) Ltd
15 Cheslind Textiles Ltd.
16 Chida Spg. Mills (P) Ltd.
17 Classic Spinning Mills Pvt. Ltd.
18 Coimbatore Polytex Private Ltd.
19 D B V Cotton Mills (P) Ltd.
20 Durairaj Mills Limited II
21 Eastman Spinning Mills (P) Ltd.
22 Edarikkode Textiles
23 Emperor Textiles (P) Ltd
24 Ennar Spinning Mills (P) Ltd
25 G T N Industries Ltd
26 G T N Textiles Ltd.
27 G V D Textiles (P) Ltd
28 Gangai Spinning Mills
29 Gangotri Textiles Ltd.**
30 Gem Spinners India Ltd.
31 Gokak Mills (4)
32 Gopalakrishna Textile Mills Pvt. Ltd
33 Harshini Textiles Ltd
34 Himatsingka Seide Limited
35 Hindustan Cotton Spinning Mills (New)
36 Jagannath Textile Company Ltd
37 Jai Jagadhambiga Textile Mills P. Ltd
38 Jay Textiles -Unit II (Super Sales India Ltd.)
39 Jayavarma Textiles (P) Ltd - Unit 2
40 K G Mills
41 K G S Mills
42 K K P Spinning Mills Ltd
43 K L R F Textiles(A Division of KLRF Ltd)(2)
44 K N M Textiles*
45 Kallam Spinning Mills Ltd
46 Kandagiri Spg. Mills Ltd - Unit I
47 Kaveri Yarns and Fabrics Ltd.
48 Kayaar Exports Private Limited
49 Kottayam Textiles
50 L S Mills Ltd.
51 Lakshmi Ganesha Textiles Ltd
52 Lakshmi Machine Works Ltd.
53 Madura Coats Private Limited (4)
54 MAG Solvics (P) Ltd
55 Malabar Spg. & Wvg. Mills
56 Mallur Siddeswara Spg. Mills Pvt. Ltd.
57 Maris Spinners Ltd.
58 Modern Cotton Yarn Spinners Limited
59 N S P Knitting Mills
60 Nagammai Cotton Mills (P) Ltd
61 Nandhi Vardhana Textile Mills Limited (New)
62 Narasu's Spg. Mills
63 National Textile Corporation (TN&P) Ltd. (16)
64 Pioneer Spg. & Wvg. Mills Ltd. *
65 Prabhuram Mills
66 Prachidhi Spinners Pvt. Ltd,
67 Precot Meridian Ltd. (5)
68 Premier Mills Private Ltd.
69 Premier Spg. & Wvg. Mills Ltd.
70 Premier Tex Products P.Ltd
71 Prithivraj Textiles
72 Ramani Textile Mills (P) Ltd
73 Rasi Tex (IN) P. Ltd.
74 Rithanyaa Textiles
75 Rugmini Ram Raghav Spinners Ltd.
76 S.A. Aanandan Spinning Mills (P) Ltd
77 S C M Textile Spinners
78 S P Spinning Mills Ltd.
79 Salona Cotspin Limited
80 Sangeeth Textiles Ltd.
81 Sarmangal Synthetics Limited
82 Saudagar Enterprise
83 Selvaraja Mills Pvt. Ltd.
84 Seyad Cotton Mills Ltd.
85 Shanmugappriya Textiles Ltd.
86 Shiva Texyarn Limited
87 Shri Cheran Synthetics India Ltd
88 Shri Govindaraja Mills Ltd,- B Unit
89 Shri Ramalinga Mills Ltd.
90 Shri Santhosh Meenakshi Textiles Private Limited
91 Soundararaja Mills Ltd.
92 Southern Spinners and Processors Limited
93 SP Superfine Cotton Mills (P) Ltd
94 Sree Akkamamba Textiles Ltd.
95 Sree Ayyanar Spg. & Wvg. Mills Ltd - Unit I (2)
96 Sree Ganesar Textile Mills Ltd.
97 Sree K N M Spg. Mills (P) Ltd.
98 Sree Narasimha Textiles (P) Ltd.
99 Sree Prashant Spinners Ltd.
100 Sree Satyanarayana Spg. Mills Ltd.
101 Sri Anjaneya Cotton Mills Pvt.Ltd
102 Sri Dhanalakshmi Cotton & Rice Mills Pvt. Ltd.
103 Sri Gomathy Mills Private Limited
104 Sri Kannapiran Mills Ltd.
105 Sri Kannattal Mills P. Ltd.
106 Sri Karthikeya Spg. & Wvg. Mills Ltd.
107 Sri Karunambikai Mills Pvt. Ltd
108 Sri Kumaran Mills Limited.
109 Sri Lakshmikantha Spinners Ltd (New)
110 Sri Lakshmi Saraswathi Textiles (Arni) Ltd.
111 Sri Mahasakthi Mills Ltd
112 Sri Muni Pachaiyappan Textiles (P) Ltd.
113 Sri Nachammai Cotton Mills Ltd.
114 Sri Raghava Textiles Ltd.**
115 Sri Ramakrishna Mills (CBE) Ltd.
116 Sri Ramnarayan Mills Ltd.
117 Sri Ramiah Spinners Ltd,'B' Unit
118 Sri Ranga Textiles (P) Ltd.
119 Sri Sakthi Textiles Ltd.
120 Sri Saravana Spinning Mills Ltd
121 Sri Selvapathy Mills (P) Ltd
122 Sri Shanmugavel Mills Pvt. Ltd.
123 Sri Varadaraja Textiles Ltd.
124 Sri Venkatalakshmi Spinners (P)Ltd.
125 Sri Vignesh Yarns (P) Limited
126 Subadra Textiles Pvt. Ltd.
127 Super Spg. Mills Ltd. (3)
128 Suryavanshi Spinning Mills Ltd
129 T T Limited-(Unit Tirupathi Spinning Mills)
130 The Banhatti Co-op. Spg. Mills Ltd.
131 The Bharathi Co-op. Spg. Mills Ltd.
132 The Kadri Mills (CBE) Ltd.
133 The Lakshmi Mills Co.Ltd. (4)
134 The National Sewing Thread Co.Ltd
135 The Palani Andavar Mills Ltd.
136 The Pondicherry Co-op. Spg. Mills Ltd.
137 The Rajaratna Mills Ltd. (2)
138 The Southern Textile Ltd
139 The Sri Venkatesa Mills Ltd.
140 The Tamilnadu Handloom Weavers' Co-op.Society Ltd
141 The Tamilnadu Textile Corporation Ltd
142 Tirupur Textiles Private Ltd. (3)
143 Tirupur Thirukkumaran Textiles (P) Ltd

Note: Figures in brackets indicate number of units, * Council decision pending ** Resignation submitted

ANNEXURE XI (Contd.)

SITRA MEMBER MILLS

144 Umayal Spinners (P) Ltd
145 V.R Textiles Pvt Ltd
146 Veejay Lakshmi Textiles Limited (2)
147 Veejay Syntex Pvt. Ltd.
148 Velathal Spg. Mills (P) Ltd *
149 Vijay Velavan Spinning Mills (P) Ltd
150 Vishnu Lakshmi Mills (P) Ltd
151 Viswabharathi Textiles Ltd.
152 VTM Limited
153 VTX Industries Ltd

Associate Members

1 Ashoka Multiyarn Mills Limited
2 B L P Super Spinners, (Unit of PBM Polytex Ltd)
3 Br.Sheshrao Wankhede Shetkari Sahakari Soot Girni Ltd
4 Banswara Syntex Ltd*
5 Chandra Textiles Ltd.
6 Cheviot Company Ltd
7 Eurotex Industries & Exports Ltd.
8 George Distributors (P) Ltd
9 Gillanders Arbuthnot & Company Ltd*
10 Gimatex Industries Pvt.Ltd
11 Ginni Filaments Ltd
12 Gloster Jute Mills Ltd
13 Gujarat Heavy Chemicals Ltd. Unit : Sree Meenakshi Mills
14 Indira Sahakari Soot Girni Ltd.
15 Kanco Overseas
16 Kangwal Textile Company Limited,
17 Keshar Multiyarn Mill Ltd
18 Loyal Textile Mills Ltd.
19 Mafatlal Industries Limited
20 Mahalakshmi Fibres & Industries Ltd.
21 Nagammal Mills Ltd.
22 Nagreeka Exports Ltd.
23 P B M Polytex Ltd.
24 Pee Vee Textiles Limited
25 Pratibha Syntex Limited
26 Priyadarshini Sahakari Soot Girani Ltd
27 PT. Indo Liberty Textiles
28 Rajapalayam Mills Ltd.
29 RSWM Limited (3)
30 Reliance Industries Ltd.
31 Rishab Spinning Mills (Prop.Nahar Exports Ltd.)
32 Sambandam Spg Mills Ltd.
33 Shetkari Sahakari Soot Girni Ltd.
34 Sholingur Textiles Ltd.
35 Shriganesh Textile & Infrastructure (I) Pvt. Ltd (New)
36 Sree Katteri Textiles Pvt. Ltd.*
37 Sree Valliappa Textiles Ltd.
38 Sri Jayajothi & Co Ltd
39 STI India Limited
40 Surya Prabha Mills Private Ltd.
41 Suryalakshmi Cotton Mills Ltd.
42 The Gobald Textiles Pvt. Ltd.
43 The Jamshri Ranjitsinghji Spg.& Wvg.Mills Ltd.
44 The Rai Saheb Rekchand Mohata Spg & Wvg Mills Ltd.**
45 The Suguna Mills Pvt. Ltd.
46 Thiagarajar Mills Ltd. (2)
47 The Tuticorin Spinning Mills Ltd.
48 Vippy Spinpro Ltd
49 Visaka Industries Ltd.
50 Voltas Ltd.

TSC Members

1 Hanjung Exim Private Limited
2 Kanakalakshmi Mills (P) Ltd
3 A.R.Appasamy
4 East India Commercial Co.Ltd
5 Lakshmi Spinners
6 Prathishta Weaving & Knitting Co.Ltd
7 Sre Venkatachalapathy Textiles
8 Nilgiri Textiles (P) Ltd.
9 Rimtex Engineering Pvt Ltd
10 Muthu Spinning Mills (P) Ltd.,
11 Kikani Exports Pvt.Ltd.,
12 Techno Electronics & Instruments
13 Jacquard Fabrics (India) Pvt.Ltd
14 Sri Jagannatha Spinners Pvt.Ltd
15 Sree Ranganathar Mills
16 Sri Choleeswarar Spg. Mills
17 JVS Spinners (India) Limited
18 Thirumurugan Spinners
19 Sri Santhalakshmi Mills Private Ltd
20 Micrro Cotspinn India (P) Ltd
21 Ess Kay Yarn Dyeings
22 Jai Sakthi Mills
23 Sri Krishna Textiles
24 PEE AAA Impex
25 Veda Finneblend Private Limited
26 Anishkumar Spinning Mill
27 Yuvraj Lube & Petrochemical Pvt Ltd
28 Global Spinners
29 Fab Yarns
30 Sky Cotex India Private Limited
31 Habasit Iakoka Pvt Ltd
32 Geena Garments
33 Jayanthi Textile Products
34 Veejay Terry Products Ltd
35 Thirumalsree Spinners Pvt. Ltd

Note: Figures in brackets indicate number of units * Council decision pending ** Resignation submitted

FINANCIAL STATEMENTS
AS ON
31st MARCH 2014

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

COIMBATORE - 641 014

Independent Auditors' Report

To

The Members of The South India Textile Research Association

Report on the Financial Statements

1. We have audited the accompanying financial statements of **The South India Textile Research Association** (the "Association"), which comprise the Balance Sheet as at March 31,2014 and Income and Expenditure Account for the year then ended.

Management's Responsibility for the Financial Statements

2. The Association's Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position and financial performance of the Association. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility

3. Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we com ply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

4. An audit involves performing procedures to obtain audit evidence, about the amounts and disclosures in the financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditors consider internal control relevant to the Association's preparation and fair presentation of the financial statements in order to design audit procedures that are ap propriate in the circumstances. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by Management, as well as evaluating the overall presentation of the financial statements.

5. We believe that the audit evidence we have obtained is sufficient and ap propriate to provide a basis for our audit opinion.

Opinion

6. In our opinion, and to the best of our information and according to the explanations given to us, the accompanying financial statements give a true and fair view in conformity with the accounting principles generally accepted in India:

   (a) in the case of the Balance Sheet, of the state of affairs of the Association as at March 31, 2014; and
   (b) in the case of the Income and Expenditure Account, of the Excess of Income over Expenditure for the year ended on that date.

7. We report that:

   (a) We have obtained all the information and explanations which, to the best of our knowledge and belief, were necessary for the purpose of our audit;

   (b) The Balance Sheet and Income and Expenditure Account dealt with by this Report are in agreement with the books of account;

For P.N.Raghavendra Rao & Co.,
Chartered Accountants
Firm Registration Number : 003328S

Sd/- M.Bhaskar
Partner
Membership Number : 025073

Coimbatore
August 29, 2014

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

BALANCE SHEET AS AT 31ST MARCH 2014

Amount in Rs

Particulars	Schedule No.	2013-14	2012-13
LIABILITIES			
Corpus/Capital Fund	1	2,77,39,023	2,75,22,115
Capital Grant from Ministry	2	36,79,31,902	36,17,77,697
Reserves and Surplus	3	49,28,87,952	47,79,47,875
Current Liabilities and Provisions	4	7,68,77,264	5,29,79,343
TOTAL (A)		**96,54,36,142**	**92,02,27,031**
ASSETS			
Fixed Assets - Net Block	5 & 6	45,82,64,883	38,11,76,448
Investments	7	38,90,99,739	41,61,48,359
Sponsored Projects	8	2,48,46,559	4,91,03,727
Current Assets, loans, Advances etc	9	9,32,24,962	7,37,98,497
TOTAL (B)		**96,54,36,142**	**92,02,27,031**

Place : Coimbatore
Date : 29th August 2014

For P.N.Raghavendra Rao & Co.,
Chartered Accountants
Sd/-
(M.Bhaskar)
Partner

(Sd/-) D. Krishnamurthy (Chairman)
" E. Sathyanarayana

(Sd/-) Prakash Vasudevan (Director)
" B.K. Krishnaraj Vanavarayar

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2014

Amount in Rs.

Particulars	Schedule No.	31.03.2014	31.03.2013
INCOME			
Income from Services	10	5,05,28,717	4,28,34,903
Membership/Ministry Contribution	11	1,62,89,387	1,41,81,791
Sponsored Projects - Overhead Recoveries	12	69,20,685	87,16,830
Other Income	13	91,65,381	1,19,33,635
TOTAL (A)		**8,29,04,170**	**7,76,67,158**
EXPENDITURE			
Establishment Expenses	14	4,53,77,090	3,79,35,331
Administrative Expenses	15	2,13,34,712	2,02,61,756
Repairs and Maintenance	16	48,47,233	56,36,045
Stores Consumed	17	7,40,490	8,79,698
Finance Charges	18	21,580	8,324
Sponsored Projects - SITRA Contribution	19	29,26,577	23,44,104
Depreciation	20	56,07,535	56,59,843
TOTAL (B)		**8,08,55,217**	**7,27,25,100**
Balance being excess of Income over Expenditure for the year		20,48,954	49,42,058
Appropriated from Infrastructure Devel. & Maintenance Reserve		19,19,095	17,73,140
Appropriated from Staff Benefit Reserve - SITRA		29,75,036	28,11,992
Balance Surplus		**69,43,085**	**95,27,190**
Transfer to Staff Benefit Reserve - SITRA		35,00,000	92,00,000
Transfer to Corpus Reserve for R & D		31,00,000	-
Transfer to General Reserve		**3,43,085**	**3,27,190**

Place : Coimbatore
Date : 29th August 2014

For P.N.Raghavendra Rao & Co.,
Chartered Accountants
Sd/-
(M.Bhaskar)
Partner

(Sd/-) D. Krishnamurthy (Chairman)
" E. Sathyanarayana

(Sd/-) Prakash Vasudevan (Director)
" B.K. Krishnaraj Vanavarayar

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

Schedules to Balance Sheet for the year 2013-14

Amount in Rs

Schedules	2013-14	2012-13
Sch - 1		
Corpus/Capital Fund		
Contribution from Member Mills	2,75,22,115	2,76,35,979
Add: Received during the year	2,58,080	2,08,342
	2,77,80,195	2,78,44,321
Less: Loss on Disposal of Assets	41,172	3,22,206
Total	**2,77,39,023**	**2,75,22,115**
Sch - 2		
Capital Grant from Ministry		
Cotton Textile Fund Committee	12,53,791	12,53,791
Council of Scientific and Industrial Research	22,69,513	22,69,513
Ministry of Textles	29,66,019	29,66,019
MOT/Office of the Textile Commissioner - Spon Projects	10,66,57,064	10,34,67,039
Ministry of Textiles - Sponsored CAD Centre	48,82,780	48,82,780
Ministry of Textiles - Centre of Excellence - Meditech	19,99,87,830	19,70,49,340
MOT/Office of the Textile Commissioner - PLSC	4,99,14,905	4,98,89,215
Total	**36,79,31,902**	**36,17,77,697**
Sch - 3		
Reserves & Surplus		
General Reserve	6,51,13,788	15,35,17,937
Asset Stabilisation Reserve	8,18,49,399	3,15,04,798
Corpus fund for Research and Development Reserve	6,79,64,259	6,14,68,342
Infrastructure Development and Maintenance Reserve	5,39,11,438	5,14,45,684
Staff Benefit Reserve - SITRA	5,53,15,613	6,17,01,320
Staff Benefit Reserve - PLSC	84,58,605	92,86,988
Centre of Excellence Building Reserve	5,79,09,505	1,71,13,893
Depreciation Reserve Invt.Interest	10,06,33,480	8,49,48,108
PLSC/CAD Centre Reserve	17,31,864	69,60,805
Total	**49,28,87,952**	**47,79,47,875**
Sch - 4		
Current Liabilities & Provisions		
Current Liabilities		
Unspent grant		
Unspent Grant - Upgradation PSC	45,81,096	46,06,786
Unspent grant - ISDS Capital Expenditure	4,70,03,941	8,97,758
Unspent grant - COE	56,35,797	21,99,314
Unspent Grant -SSY	1,19,50,800	63,52,000
Liability for Purchases & Expenses	2,61,766	1,41,44,788
Liability For Others	32,06,520	43,69,617
Total (A)	**7,26,39,919**	**3,25,70,263**
Provisions	-	
ISDS Provision for Expenses	4,68,389	1,47,96,668
Provision for Expenses -SITRA	7,21,930	8,68,810
Provision for Bill Payable - COE	1,70,546	9,85,163
Provision for Expenses - COE	9,36,496	16,04,186
Provision for Expenses - PLSC	19,39,984	21,54,253
Total (B)	**42,37,345**	**2,04,09,080**
Total (A + B)	**7,68,77,264**	**5,29,79,343**

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

Schedules to Balance Sheet for the year 2013-14

Fixed Assets Amount in Rs

Schedules	2013-14	2012-13
Sch - 5		
Gross Assets		
Land	5,11,107	5,11,107
Building	3,43,50,903	3,43,50,903
Plant And Machineries	8,99,71,419	8,48,97,899
Furniture & Fittings	43,04,720	39,98,664
Computer And Accessories	50,43,608	49,69,808
Library	25,01,417	24,89,834
Vehicle	15,07,934	14,46,239
COE Building Capital Work in Progress	6,22,61,580	1,71,13,893
COE Building Equipment & Electrical	37,45,432	-
Total	**20,41,98,120**	**14,97,78,347**
Sch - 6		
Fixed Assets under Sponsored Projects		
The South India Textile Research Association	7,11,38,165	7,13,93,531
Integrated Skill Development Scheme	2,20,62,697	1,91,02,241
Centre of Excellence - Meditech	20,23,41,806	17,73,71,686
Powerloom Service Centre	5,12,55,072	5,08,84,781
Total	**34,67,97,740**	**31,87,52,239**
Total Gross Block	**55,09,95,860**	**46,85,30,586**
Depreciation Reserve		
Depreciation Reserve - Building	86,68,696	82,60,610
Depreciation Reserve - Computer & Accessories	22,10,272	20,56,433
Depreciation Reserve - Furniture And Fixtures	16,82,656	15,81,684
Depreciation Reserve - Plant & Machinery	5,93,75,855	5,54,82,250
Depreciation Reserve - Vehicles	87,256	(20,793)
Depreciation Reserve - ISDS	15,50,129	8,37,840
Depreciation Reserve PLSC & CAD	1,91,56,113	1,91,56,113
Total	**9,27,30,977**	**8,73,54,138**
Net Block	**45,82,64,883**	**38,11,76,448**
Sch - 7		
Investments		
Depreciation Reserve Investment	19,01,56,267	17,22,19,152
Corpus Reserve for Research and Development Investment	4,24,98,395	3,91,02,478
Infrastructure Development & Maintenance Reserve Investment	4,62,16,484	4,37,50,720
Staff Benefit Reserve Investment	6,00,18,299	4,42,98,492
General Reserve Investment	4,92,45,294	11,09,77,517
PLSC/CAD Centre Reserve Investment	9,65,000	58,00,000
Total	**38,90,99,739**	**41,61,48,359**
Sch -8		
Sponsored Projects - Grant Receivable		
As per Schedule	2,48,46,559	4,91,03,727
Total	**2,48,46,559**	**4,91,03,727**

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

Schedules to Balance Sheet for the year 2013-14

Amount in Rs

Schedules	2013-14	2012-13
Sch - 9		
Sundry Debtors		
Sundry Debtors	11,29,677	8,06,045
Total	**11,29,677**	**8,06,045**
Cash & Bank Balances		
Cash on Hand	71,847	90,890
Cash at Bank	6,18,75,829	1,43,82,589
Cash at Bank PLSC	19,98,203	15,72,719
Cash at Bank CoE	1,09,90,118	78,18,906
Total	**7,49,35,996**	**2,38,65,104**
Loans & Advances		
Deposits - Others	17,95,638	24,32,367
Advance - Expenses	28,67,820	20,58,828
Advances for Purchases and Others	1,24,95,830	4,46,36,152
Total	**1,71,59,288**	**4,91,27,348**
Grand Total	**9,32,24,962**	**7,37,98,497**

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

Schedules to Balance Sheet for the year 2013-14

Amount in Rs

Schedules	2013-14	2012-13
Sch - 10		
Income from Services		
Testing and Investigation Fee	3,59,74,181	3,42,28,427
HRD Education Receipts	37,88,183	30,52,188
Publication Income	7,83,625	5,13,536
Income from COE	99,82,728	50,40,753
Total	**5,05,28,717**	**4,28,34,903**
Sch - 11		
Membership/Ministry Contribution		
From Ministry of Textiles	1,06,13,000	91,00,000
From Membership Contribution	54,91,387	48,97,791
From Technical Service Card Membership Fees	1,85,000	1,84,000
Total	**1,62,89,387**	**1,41,81,791**
Sch - 12		
Sponsored Projects - Overhead Recoveries	69,20,685	87,16,830
Total	**69,20,685**	**87,16,830**
Sch - 13		
Other Income		
Interest Income from Investment and Advances	27,24,416	33,16,059
Staff Quarters Rent	4,96,381	4,70,633
Miscellaneous Income and Royalty Receipts	32,38,980	43,88,504
Allocation of Expenses incurred by SITRA for COE	7,65,620	16,04,186
Allocation of Expenses incurred by SITRA for PLSC	19,39,984	21,54,253
Total	**91,65,381**	**1,19,33,635**
Sch - 14		
Establishment Expenses Non-Plan		
Salary and Other Allowances	4,99,34,126	4,97,81,124
Sitra Contributory PF and other Funds	40,84,383	19,90,914
	5,40,18,509	5,17,72,038
Less: Allocated to Sponsored Projects	24,17,848	21,62,943
Allocated to Integrated Skill Development Scheme	18,11,880	1,16,73,764
Terminal Benefits (Provision 2013-14) appropriated from Reserve	44,11,691	-
Total	**4,53,77,090**	**3,79,35,331**

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

Schedules to Balance Sheet for the year 2013-14

Amount in Rs

Schedules	2013-14	2012-13
Sch - 15		
Administrative Expenses Non-Plan		
Travelling Expenses	8,46,204	17,18,067
Printing & Stationery	5,64,233	2,11,923
Publication Expenses	2,13,730	4,66,594
Postage, Telegrams and Telephone Charges	9,39,972	10,46,424
Journals and Periodicals	1,72,532	2,47,954
Electricity Charges	35,76,582	42,49,491
Building & Fire Insurance	5,87,895	69,455
Rent, Rates and Taxes	4,77,103	2,55,628
Advertisement Charges	68,507	82,772
Training Course Expenses	13,92,613	2,54,026
Conferences, Seminars and Meetings	5,91,901	10,94,626
Audit Fees	50,000	43,000
Internal Audit Fees	1,15,650	2,74,073
Certification Charges	32,000	34,000
Office Expenses	6,70,739	8,53,256
SITRA Textile Service Centre Expenses	1,69,244	2,41,906
Expenditure COE	89,25,823	69,64,308
Expenditure PLSC	19,39,984	21,54,253
Total	**2,13,34,712**	**2,02,61,756**
Sch - 16		
Repairs & Maintenance		
Maintenance of Motor Cars and Vehicles	1,27,693	1,57,924
Maintenance of Machinery	9,01,903	13,95,754
Maintenance of Office Equipment	4,64,525	6,20,427
Maintenance of Building & Staff Quarters	33,18,995	34,47,214
Maintenance of Furniture	34,117	14,726
Total	**48,47,233**	**56,36,045**
Sch - 17		
Stores Consumed	**7,40,490**	8,79,698
Total	**7,40,490**	**8,79,698**
Sch - 18		
Finance Charges		
Bank Charges and Commission	21,580	8,324
Total	**21,580**	**8,324**
Sch - 19		
Sponsored Projects - SITRA Contribution	29,26,577	23,44,104
Total	**29,26,577**	**23,44,104**

Place : Coimbatore
Date : 29th August 2014

For P.N.Raghavendra Rao & Co.,
Chartered Accountants
Sd/- (M.Bhaskar) Partner

(Sd/-) D. Krishnamurthy (Chairman)
" E. Sathyanarayana

(Sd/-) Prakash Vasudevan (Director)
" B.K. Krishnaraj Vanavarayar

Schedules to Balance Sheet for the year 2013-14

Schedule 20

DEPRECIATION FOR THE YEAR 2013-2014

Amount in Rs.

S.No.	Name of the Asset	COST				DEPRECIATION			WDV	
		Value as on 01.04.2013	Additions During 2013-2014	Deletion During 2013-14	Value as on 31.03.2014	Depreciation As on 01.04.2013	Deletion During 2013-14	Depreciation for the year 2013-14	W.D.V As on 31.03.2013	Closing W.D.V As on 31.03.2014
1	Land	5,11,107	-	-	5,11,107	-	-	-	5,11,107	5,11,107
2	Library	24,89,834	11,583	-	25,01,417	-	-	-		
3	ISDS - Library	13,73,683	20,30,976	-	34,04,659				38,63,516	59,06,075
4	Building	3,35,28,818	-	-	3,35,28,818	78,95,841	-	4,34,169	2,63,92,705	2,62,01,985
5	ISDS - Building Renovation	7,59,728	2,43,449	-	10,03,177					
6	Auditorium	5,03,235	-	-	5,03,235	1,94,608	-	5,031	3,08,627	3,03,596
7	Staff Quarters	2,37,543	-	-	2,37,543	1,04,393	-	2,170	1,33,150	1,30,980
8	Furniture	39,98,664	3,06,056	-	43,04,720	15,65,788	-	1,48,260	38,02,368	42,90,672
9	ISDS - Furniture	13,69,492	3,30,508	-	17,00,000					
10	Electrical Fittings	81,307	-	-	81,307	65,768	-	519	15,539	15,020
11	PLSC - Furniture	27,685	-	-	27,685	15,896	-	402	11,789	11,387
12	Machinery	8,46,91,630	52,08,260	3,90,366	8,95,09,524	5,53,13,023	2,30,694	38,37,805	6,99,33,283	7,11,44,066
13	Sponsored Projects - Assets	4,05,54,676	-	-	4,05,54,676					
14	ISDS - Machinery	1,19,99,338	-	-	1,19,99,338	6,54,836	-	5,84,242	1,13,44,502	1,07,60,260
15	ISDS-PSC-Machinery	36,00,001	-	-	36,00,001	1,83,004	-	1,75,975	34,16,997	32,41,021
16	ISDS - Machinery Phase II	-	3,55,523	-	3,55,523	-	-	18,309	-	3,37,214
17	PLSC- Machinery	4,33,949	-	-	4,33,949	1,69,227	-	13,633	2,64,722	2,51,089
18	Computer	49,69,808	73,800	-	50,43,608	20,56,433	-	1,53,840	29,13,375	28,33,336
19	Motor Cars	13,78,119	-	-	13,78,119	(47,699)	-	1,00,805	14,25,818	13,25,013
20	Motor Cycles & Scooters	68,120	61,695	-	1,29,815	26,906	-	7,276	41,214	95,633
21	CoE Building Electrical Equipments	-	37,45,432	-	37,45,432	-	-	1,25,097	-	36,20,335
22	UNDP Jute Project Machinery	1,71,49,069	-	-	1,71,49,069	-	-	-	1,71,49,069	1,71,49,069
23	Assets under Sponsored Projects - SITRA	1,34,34,420	-	-	1,34,34,420	-	-	-	1,34,34,420	1,34,34,420
24	COE Machinery Assets	17,73,71,686	2,49,70,120	-	20,23,41,806	-	-	-	17,73,71,686	20,23,41,806
25	PLSC Assets	5,08,84,781	3,70,551	-	5,12,55,332	1,91,56,113	-	-	3,17,28,668	3,20,99,219
26	COE Building Work-In Progress	1,71,13,893	4,51,47,687	-	6,22,61,580	-	-	-	1,71,13,893	6,22,61,580
	Total	**46,85,30,586**	**8,28,55,640**	**3,90,366**	**55,09,95,859**	**8,73,54,138**	**2,30,694**	**56,07,535**	**38,11,76,448**	**45,82,64,883**

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION

Schedules to Balance Sheet for the year 2013-14

Schedule 8

Financial Status of Sponsored Projects : 01/04/2013 - 31/03/2014

Amount in Rs.

Sl.No.	Name of Sponsored Project	Opening Balance of Grant up to 01.04.2013		Receipts	Total Receipts as on 31/03/2014	Total Expenditure As At 31/03/2014				Balance (MOT Contribution) As At 31/03/2014
						Sitra contribution		MOT contribution		
		Upto 2011-2012	2012-2013	Funds Received during the year 2013-14		Upto 31/03/2013	For 2013-14	Upto 31/03/2013	For 2013-14	
1	**Ministry of Textile Sponsored Research Projects**									
a	Controlled Drug Release on Chitosan-coated Cotton Gauze	13,20,000		8,80,000	22,00,000	6,00,000		22,00,000	-	-
b	Devlopment of Rotator Cuff Repair Devices for Shoulder	28,80,000			28,80,000			48,00,000	-	(19,20,000)
c	Development of Special wound care Dressing made of PVA/chito	14,40,000		9,20,000	23,60,000	6,00,000		23,96,222	-	(36,221)
d	Development of Compression Bandage Pressure	27,30,000		18,20,000	45,50,000	-		45,50,000	-	-
e	Development of wound dressing made of electro spun herbal	7,65,000		-	7,65,000	1,95,694	6,54,306	7,34,064	18,15,936	(17,85,000)
f	Hospital Bed Linens with Enhanced Thermal Properties	7,45,000		-	7,45,000	2,39,989	5,87,511	8,11,572	16,70,928	(17,37,500)
g	Design & Fabrication of an instrument to assess the resistance	8,14,000		-	8,14,000	3,52,258	5,52,242	11,83,294	15,30,207	(18,99,500)
h	Development of Textile Matrices for the effective wound		11,02,500	-	11,02,500	1,32,090	5,23,157	3,96,269	17,16,451	(10,10,220)
i	Design & Dev. Of an Automated Equipment to produce Knotless		9,76,500	-	9,76,500	1,16,497	2,93,256	3,49,491	9,71,372	(3,44,362)
j	Development of a Leukodepletion Blood Filter		9,22,500	-	9,22,500	1,07,576	3,16,106	3,22,727	10,74,837	(4,75,064)
		1,06,94,000	**30,01,500**	**36,20,000**	**1,73,15,500**	**23,44,104**	**29,26,577**	**1,77,43,638**	**87,79,732**	**(92,07,867)**
							52,70,681		**2,65,23,369**	

Sl.No.	Name of Sponsored Project	Opening Balance 2012-13	Receipts		Expenditure		Total Expenditure As At 31/03/2014	Balance As At 31/03/2014		
			Funds Received during the year 2013 - 14	Revenue / Appropriation	Recurring	Capital		Unspent	SITRA	Due
2	**Ministry sponsored powerloom service centre receipts**	-	1,14,00,000.00	79,24,560	1,93,24,560.00	-	1,93,24,560	-	-	-
3	**SITRA Integrated Skill Development Scheme**									
	Phase I	(4,36,81,968)	2,23,00,000	1,09,64,460	91,20,102	26,04,933	1,17,25,034	-	(95,47,542)	(1,25,95,000)
	Phase II	-	4,79,40,000	-	5,80,536	3,55,523	9,36,059	4,70,03,941		
4	**International Training Programme**	(10,69,866)	65,94,669	-		83,49,450	83,49,450	-		(28,24,647)
5	**CoE Projects**									
i	Office of the Textile Commissioner	80,000	6,40,000	-	9,39,045	-	9,39,045	-		(2,19,045)
ii	Department of Science & Technology	-	7,00,000	-	1,44,743	1,78,398	3,23,141	3,76,859		-
iii	Engagement of Consultant under TMTT	52,58,938	-	-	-	-	-	52,58,938		-
		(3,94,12,896)	**8,95,74,669**	**1,88,89,020**	**3,01,08,986**	**1,14,88,304**	**4,15,97,289**	**5,26,39,738**	**(95,47,542)**	**(1,56,38,692)**
										(2,48,46,559)