January 2023 - December 2023 No. 7.1

SITRA e -Techletter

...News during the Year

Inside This issue...

Productivity Deleberations

Commercial performance of spinning mills during the period January – December 2023

SITRA's monthly online survey and yearly inter-mill study on “Costs, operational performance and yarn quality (CPQ study)” gives detailed information about commercial and operational performance of the spinning industry as a whole.

Based on the commercial performance of cotton yarns that were reported by the participants in the monthly online surveys, SITRA has developed an index called MPEI (Market Performance Evaluation Index), which is an arithmetic index that is derived by having April 2013 as the base month and the base index set to 100 for that month. The calculation of MPEI is based on the average net output value (yarn selling price – clean raw material cost) in terms of Rs per kg of yarn for 10 popular counts which occupies a considerable proportion in the market share with a wide range. The popular counts that have been assumed to arrive at the MPEI are 40s K, 40s C, 60s C, 80s C, 40s C-Comp., 50s C-Comp., 60s C-Comp., 80s C-Comp., 30s CH and 40s CH.

The trend in the movement of MPEI for the period January – December 2023 is shown in Figure 1. Similarly, the trend in the movement of yarn selling price index and raw material cost index during the period January – December 2023 is shown in

Productivity Deleberations

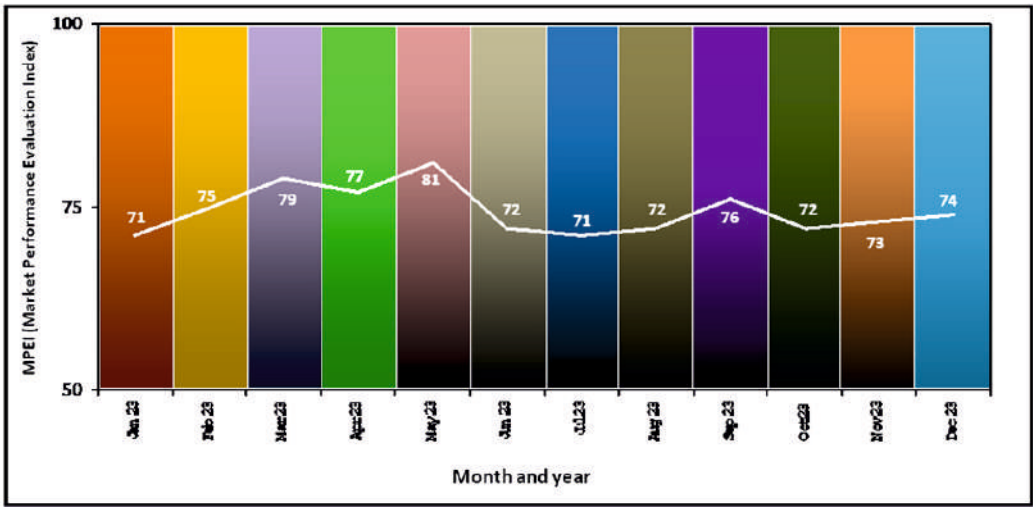


Figure 1 Market Performance Evaluation Index (MPEI)

During the year 2023, MPEI averaged at 75 index points, which is 12 index points lower than the index that prevailed in the previous year (2022). Between months, MPEI fluctuated widely ranging from a low value of 71 index points in January 2023 to 81 index points in May 2023.

In the 1st quarter, MPEI started with a low value of 71 index points, with yarn selling price index at 121 points and raw material cost index at 168 points. In the subsequent months, the raw material witnessed a significant drop with marginal reduction in yarn selling price. Due to the above, the MPEI had increased to 79 index points in March 2023.

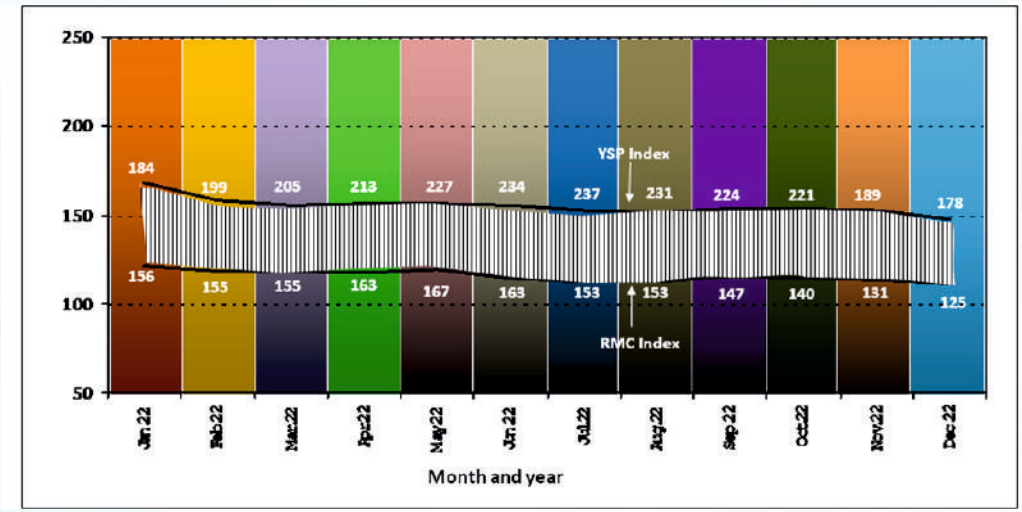


Figure 2 Yarn selling price index (YSPI) and Raw material cost index (RMCI)

Productivity Deleberations

In the second quarter (April – June 2023), consecutive ups and downs in the movement of MPEI was noticed. In April 2023, MPEI witnessed a marginal reduction of 2 index points in comparison with the previous month. However, in May 2023, it had increased to the yearly peak level of 81 points due to marginal increase in the yarn selling price. However, in the succeeding month (June 2023), the yarn selling price had registered huge reduction by 5 index points resulting in reduction of 9 index points in the MPEI (72).

In the 3rd quarter, MPEI was found hovering at around 72 index points up to August 2023 and in September 2023, a marginal increase in the yarn selling price had contributed to an increase in MPEI by 4 index points (MPEI: 76). In the last quarter (October – December 2023), MPEI was found fluctuating between 72 and 74 index points.

The performance of individual counts that were considered for MPEI during the period January – December 2023 is given in Table 1.

Table 1 Performance of individual counts in 2023

Count	YSP				RMC				NOV			
	Avg.	Min	Max.	%diff. *	Avg.	Min.	Max.	%diff. *	Avg.	Min.	Max.	%diff. *
30s CH	262	250	280	12	213	197	230	17	49	42	56	33
40s K	269	248	296	19	203	189	230	22	66	59	80	36
40s C	281	263	297	13	228	214	252	18	53	39	65	67
40s CH	278	259	290	12	209	198	232	17	68	56	77	38
40s C-Comp.	289	275	323	17	215	201	243	21	74	65	83	28
50s C-Comp.	331	309	365	18	218	203	261	29	113	101	139	38
60s C	334	321	356	11	225	213	243	14	108	95	135	42
60s C-Comp.	360	337	371	10	232	218	249	14	127	117	138	18
80s C	376	352	443	26	210	190	233	23	166	141	233	65
80s C-Comp.	422	413	440	7	238	226	251	11	184	170	206	21

'' [(Maximum/ minimum) – 1] x 100*

The above table reveals that a very wide fluctuation in net output value (NOV) in 40s C, 60s C and 80s C counts (67%, 42% and 65% respectively). However, for the same yarn counts in compact, the variation in NOV was noticed in the range of 18% to 38%. Hosiery counts witnessed a moderate variation in NOV between months. Among the counts that have been considered for the analysis, raw material cost variations were found to be more prominent than the fluctuations reflected in the yarn selling price. On the whole, 60s C-Comp., witnessed fewer variations in RMC, YSP and NOV. On the other hand, 80s C had witnessed more variations during the year with respect to RMC, YSP and NOV.

37th Costs, operational performance and yarn quality study (CPQ study)

SITRA conducted the 37th CPQ study covering data for the period April – June 2023. The summary of all mills' average as well as top 20% mills on various costs and operational factors are shown in Tables 2 to 4. Table 5 shows the comparison between 2021 and 2023, which is based on the common mills that have participated in both the years.

Productivity Deleberations

Table 2 Contribution, sale value and cost factors

Parameters	All mills' avg.	Top 20% mills avg.
Contribution		
- Rs/spindle/year	4590	9390
- Rs/kg of yarn	45	87
- As % of yarn sales	12.7	20.9
Salaries and wages cost		
- As % of yarn sales	9.2	5.7
Power cost		
- Rs/spindle/year	3560	3750
- As % of yarn sales	10.5	7.9
- Rs /unit	6.4	6.0
Raw material cost		
- Rs/kg of yarn	211	250
- As % of yarn sales	67.7	65.5
Yarn sale value		
- Rs/kg of yarn	319	391
- Rs/spindle/year	36620	47630
Average count (Ne)	45	43

Table 3 Machine and labour productivity

Particulars	All mills' avg.	Top 20% mills avg.	SITRA Std.
Machine productivity			
- Prodn./spl./8 hrs (g)*	108	115	116
- Spindle utilization (%)	91.6	94.1	98
- Machine Productivity Index (MPI)	87	95	100
Labour productivity			
- HOK (up to ring frames)*	13.8	12.7	10.2
- Ring frame Tenter Assignment Index	82	95	100
- Doffer Assignment Index	84	91	100

Table 4 Product diversification

Type of diversification	All mills' avg.	Top 20% mills avg.
Export	24	31
Combed	76	87
Hosiery	37	39
Ring doubled	4	-
TFO doubled	7	3
Compact	58	82
Gassed	3	4
100% cotton yarn	80	96
100% non-cotton yarn	9	-
Cotton/MMF blended	11	4

Table 5 Comparison of costs and operational performance between 2021 and 2023

Parameters	Common mills' (50) avg.	
	36th study (Oct.-Dec.21)	37th study (Apr.-Jun.23)
Contribution		
- Rs/spindle/year	12310	4900
Salaries and wages cost		
- Rs/spindle/year	3130	3240
Power cost		
- Rs/spindle/year	3640	3650
Raw material cost		
- Rs/kg of yarn	208	216
- Rs/spindle/year	28080	26410
Yarn sale value		
- Rs/kg of yarn	380	330
- Rs/spindle/year	46980	38200
Prodn./spl./8 hrs (g) adj. to 40s	111	109
Spindle utilization (%)	95.4	91.8
Average count (Ne)	45s	45s

3. Fibre to yarn conversion cost in 2023

Table 6 shows total conversion cost particulars for 7 different counts and type of yarns which are also based on the data that were collected in 37th CPQ study.

Table 6 Count-wise conversion cost

Period: April – June 2023

S. no.	Count	Conversion cost/kg of yarn (Rs)				Conv. cost/ kg/ count (Rs)	Conv. cost/ spl./ shift (Rs)*	No. of mills
		Avg.	Min.	Max.	CV (%)			
1.	30s CH	68.8	61.9	74.1	9.0	2.29	13.8	5
2.	30s CH-Comp.-Ex.	61.5	44.2	81.4	22.7	2.05	14.6	5
3.	40s CH	88.8	78.1	96.8	9.1	2.22	11.1	4
4.	40s CH-Comp.	73.1	67.1	85.7	11.8	1.83	11.2	4
5.	50s C-Comp.	113.8	98.8	131.4	13.0	2.28	11.5	5
6.	60s C-Comp.	140.4	117.7	170.2	13.0	2.34	10.2	9
7.	20s OE	37.2	32.2	46.1	15.2	1.86	61.1	5

* $\frac{\text{Conversion cost/kg of yarn x Prodn./spl./8 hours (g)}}{1000}$

Conversion cost and profit margin

Average net output value (NOV), conversion cost and net profit/loss in terms of Rs per spindle per shift and also as percentage of yarn sale value for the 7 counts pertaining to the period April to June 2023 are shown in Table 7.

Table 7 Count-wise conversion cost and profit margin

S. no.	Count	Rs/spindle/shift			As a % of YSP		
		NOV	CC	Net profit	NOV	CC	Net profit
1.	30s CH	9.5	13.8	(-) 4.3	18.3	26.5	(-) 8.2
2.	30s CH-Comp.-Ex.	15.5	14.6	0.9	24.4	23.0	1.4
3.	40s CH	7.2	11.1	(-) 3.9	21.6	33.3	(-) 11.7
4.	40s CH-Comp.	13.3	11.2	2.1	29.4	24.7	4.7
5.	50s C-Comp.	12.1	11.5	0.6	34.7	32.9	1.8
6.	60s C-Comp.	9.0	10.2	(-) 1.1	36.1	40.7	(-) 4.6
7.	20s OE	79.5	61.1	18.4	23.3	17.9	5.4

Note: (-) sign indicates loss; CC – conversion cost; Net profit = NOV - CC

Component-wise conversion cost

Table 8 show the component-wise average conversion cost for all the 7 counts in terms of per kg of yarn.

Table 8 Component-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 CH	259.4	211.9	21.7	23.1	8.3	2.8	12.9	68.8	(-)21.3
2.	30s CH-Comp.-Ex.	267.6	202.4	12.3	21.0	8.6	3.4	16.2	61.5	3.7
3.	40s CH	266.7	209.2	26.9	34.8	9.6	8.1	9.4	88.8	(-)31.3
4.	40s CH-Comp.	295.9	208.8	18.3	29.7	9.2	2.6	13.3	73.1	14.0
5.	50s C-Comp.	345.5	225.5	30.1	44.7	14.9	3.3	20.8	113.8	6.2
6.	60s C-Comp.	344.8	220.2	41.6	55.3	14.4	7.2	21.9	140.4	(-)15.8
7.	20s OE	207.7	159.3	6.0	15.1	7.2	1.6	7.3	37.2	11.2

(-) ve sign indicates net loss; SWC: Salaries and wages cost; OH: Overheads

Trend in the movement of conversion cost between 2010 and 2023

The movement of conversion cost in terms of Rs per kg of yarn for 5 popular counts, for which there was a sufficient representation of mills in the inter-firm studies, is shown in Figure 3.

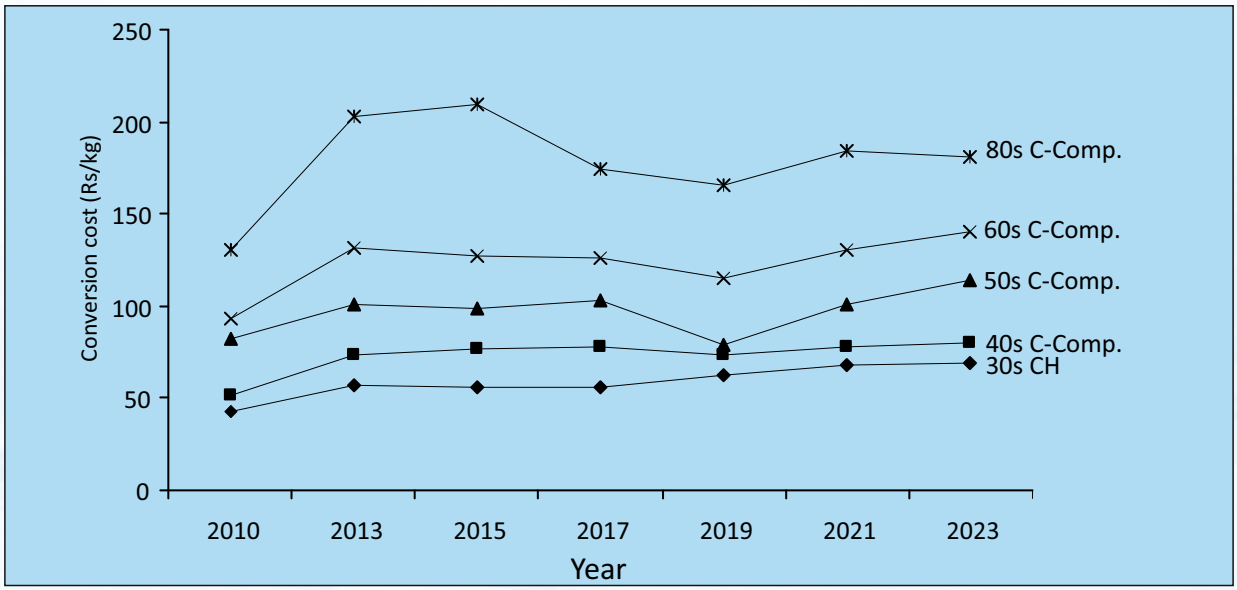


Figure 3 Movement of conversion cost between 2010 and 2023

OPENING EFFICIENCY OF BLOW ROOM LINES

Introduction

Raw material represents about 60% - 65% of the production cost of a spinning mill. Hence, the spinner requires informative knowledge of the starting material and its behavior in processing in the blow room and subsequent stages. Since the raw material (bale) enters the spinning mills in a highly compressed form, the basic operations of spinning demand the opening of the raw material. Apart from opening to get rid of the impurities that a bale of cotton carries with it (due to mechanical picking, improper method of storing, introduction of saw gins, high-density baling), a high degree of opening of the material and cleaning is necessary.

The term 'opening' in the technological sense means increasing the volume of the stock while keeping the number of fibers constant, i.e., reducing the specific density of the material. To enable an exact evaluation of the degree of opening, either the size of the stock or the density of the stock needs to be measured. Nowadays, many research methods are available to quantify the degree of opening, such as fractionators, the weight suspension of stock by open can methods and porometers. However, when compared with SITRA's development, all these techniques are costlier and more time-consuming processes.

Instrument and method to measure Openness imparted to cotton in blow room

The openness tester, developed by SITRA, is used to measure the degree of openness in cotton and the opening efficiency of blow room lines. It consists of a glass beaker with a capacity of 3000 CC, which is graduated on two diametrically opposite sides. Cotton samples taken from different beating points are placed in the beaker and flattened by gently applying a standard weight of 200 grams. After allowing the cotton to settle for 30 seconds, the volume of the cotton is noted from the graduations. It is important to ensure that the volume of the cotton sample taken for measurements falls between 1000 CC and 2000 CC to obtain reliable results. The weight of the cotton is then measured using a sensitive balance. The openness tester is shown in Figure 1.

Openness value of any opened fibre material can be found out by using the following expression:

$$\text{Openness value (O. V)} = \frac{\text{Apparent Specific Volume (A) - Actual Specfic Volume (B)}}{\text{Actual Specfic Volume (B)}}$$

$$= \frac{A - B}{B}$$

A= Apparent specific volume
B= Actual specific volume

$$\text{Apparent specific volume (A)} = \frac{V}{M}, \text{ Where}$$

D= Specific gravity of cotton
V= Apparent volume of cotton, M = Mass of cotton

$$\text{Actual specific volume (B)} = \frac{1}{D}, \text{ Where}$$

D= Specific gravity of cotton

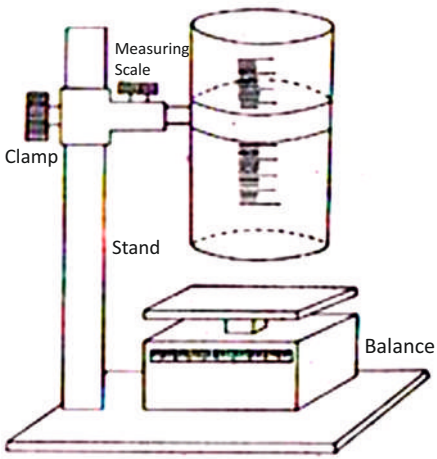


Figure 1 SITRA's openness tester

TECHNICAL NOTES

The degree of openness imparted to cotton by a blow room line is influenced by the fitness of cotton processed. Therefore the same blow room line will give different degrees of openness when different cottons are processed. Therefore, another index called opening efficiency has been derived by expressing the openness value of cotton as a percentage of the value obtained after passing the same cotton through Shirley analyser / or / card web.

Opening efficiency of a blow room line (O.E) = $\frac{X}{Y}$ x 100

Where,

X = Openness value (OV) of cotton after passing through the final beating point
Y = Openness value (OV) of the same cotton after passing through Shirley analyzer or card.

Opening efficiency values will always be lower than 100; higher the value of Openness, better is the performance of blow room line and vice versa.

The intensity of cotton in blow room line depends upon:

i) Raw material – type and quality;
ii) Machines – types, speeds & settings and
iii) Blow room - ambient conditions

All the above factors have to be considered. The use of a high degree of opening in the blow room facilitates cleaning at the card, card load and reduces shortening of the staple at the carding process.

Suggestions offered to various mills while using openness tester

1. The air temperature in the blow room has to be above 23°C, and the relative humidity should be in the range of 50-55%. Damp air leads to poor cleaning, while overly dry air can cause fiber damage.
2. Many mills have beaters with bent and worn-out points in some areas. This can create neps in cotton. Periodic replacement of worn-out parts is essential to obtain good quality feed material for carding.
3. The openness value of cotton changes as it passes through various beating points.
4. The openness imparted to cotton is influenced by the cotton conditioning time.
5. Changes in the openers imposed on cotton will affect carding behavior.
6. For process optimization, cleaning efficiency, nep generation levels, fiber rupture, lint loss and openness values should be assessed.
7. A controlled study should be conducted after making all the modifications up to the yarn stage to evaluate any improvement in yarn quality.

PROJECTS

DEVELOPMENT OF BREATHABLE, REUSABLE AND OXO-BIODEGRADABLE COVERALL USING BIOCIDAL POLYESTER

A Project sponsored by Board of Research in Nuclear Sciences (BRNS), Government of India
Collaborator: Bhabha Atomic Research Center, Mumbai, Government of India

Corona virus outbreak resulted in worldwide lockdowns and wide spread of this virus makes us to understand the importance of personal protective equipment (PPE). As a result the PPEs from polymer based materials were produced in bulk quantities but the degradability and comfort were not considered. Thus it was decided to produce coveralls from polyester fabric which have the multi- functional properties of oxo-biodegradability, improved comfort, enhanced breathability and biocidal activity in combating COVID-19. The critical task was achieving better results in barrier and moisture transfer properties simultaneously. The fabric should not only resist external parameters like blood and bodily fluids but should also allow vapour from inside to move out. These were achieved for the final coverall product as per IS 17423:2021 Level 4 requirements. Moreover, the mechanical properties of the fabric such as tensile and bursting strength were achieved as per the standard which validates the fabric's resistance against stress and strain. Also, the seam portion of the fabric showed improvised results against synthetic blood penetration and better seam strength. The fabric was durable upto 15 washes without affecting the barrier and moisture transfer properties. For the quantification of Nps on the fabric, the amount of Nps leeched from the fabric and durability of Nps on the fabric were evaluated by ISO 17294 test method using ICP-MS. The biological parameters of the Nps were evaluated based on time and concentration dependent antibacterial/antiviral activity. The fabric showed 99.9% anti-bacterial activity against Escherichia coli ATCC 25922 and 99.9% antiviral activity against Bacteriophage MS2 ATCC 15597-B1. Thus, a coverall with multi-functional properties such as breathable, anti-viral, reusable and oxo-biodegradable was developed successfully. The barrier properties were also achieved as per the requirement without compromising the moisture vapour transport properties. Even after 15 washing cycles, there was no deterioration on the fabric and it could retain all the imparted functional properties

Characterization of the final coverall

S. No	Parameters	Requirement	Prototype Specifications
1.	**Bursting Strength**		
	Dry (kPa)	≥ 40	≥ 40
	Wet (kPa)	≥ 40	≥ 40
2.	**Seam strength**		
	Dry (N)	≥ 20	≥ 20
	Wet (N)	≥ 20	≥ 20
3.	**Tensile Strength**		
	Warp (N)	≥ 20	≥ 20
	Weft (N)	≥ 20	≥ 20
4.	**SBPRT**	Pass(6 levels)	Pass(6 levels)
5.	**MVTR**($g/m^2/24h$)	> 800	957.48
6.	**Antiviral activity**	>95	99.9
7.	**VPRT**	Pass(6 levels)	Pass (6 levels)
8.	**Microbial cleanliness**	≤300	<100
9.	**Cytotoxicity**	None	None

Developed coverall

PROJECTS

ANTIOXIDANT COSMETOTEXTILES - DURABLE NANO-ENCAPSULATED VITAMIN E FINISHES ON TEXTILE FABRICS AND ITS CONTROLLED RELEASE STUDY

A Project sponsored by Department of Science and Technology under Women Scientist Scheme (DST-WOSA)

"Cosmetotextiles" is an emerging term that has been coined to designate textiles with cosmetic properties. Vitamin E can be absorbed through all the skin layers to the cell membrane and offers a healthy glow to the skin and speeds up cell regeneration. Oral dosage and topical creams and lotions may be preferable route for the vitamin E supply. But the risk involved is some of the oral vitamin E products is that they may contain excipients and preservatives such as polyethylene glycol, propylene glycol or polysorbate 80, methyl paraben and propyl paraben which have been associated with adverse drug reactions in children. In cosmetic textile fields, micro and nano-encapsulation techniques containing vitamins are being applied in order to improve safety and durability of functional materials. Nanocarriers with increased surface area and lipid carrier ability would result in higher stability and higher drug loading capacity. Nanocapsules containing vitamin E are ideal for those textile products such as underwear, towels, T-shirts and bedding that have direct contact with the skin and ensure that they sustain for a long time.

Protein-based nano carriers have gained lots of interest mainly because they are generally rescognized as safe (GRAS) and readily biodegradable as well as being non antigen in nature, great source of nutritional requirement, plentiful sustainable sources and significant binding capacity. Hence, easily available and biodegradable protein based nano formulation are applied as vehicles to entrap and deliver vitamin E.

Premature babies of very low birth weight (<1.5 Kg) might be deficient in vitamin E. This project aims to work on nano-encapsulaiton of vitamin E in fabrics meant for infants which would help to reduce the risk of some complications, such as those affecting the retina.

The nano particles were prepared by placing the bottom of a high-intensity ultrasonic horn at the interface of the protein aqueous solution and vegetable oil / tocopherol. The ratio of aqueous/organic phase and the concentrations of proteins used were optimized to obtain the particle size in the range of 1.58 to 107 nm. The characterization studies such as FT-IR, encapsulation efficiency by HPLC, HR-TEM, confocal microscopy and stability studies were performed for the prepared nano-formulation. The antioxidant activity of α-tocopherol and prepared nano formulation was evaluated by TEAC (Trolox Equivalent Antioxidant Capacity) using ABTS radical cation decolorization assay.

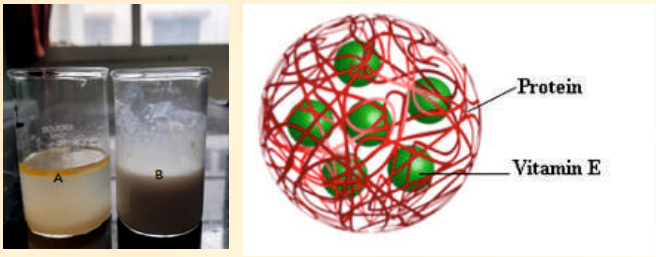


Figure 1 Visual image of formulation A) before sonication B) After sonication

Pad-dry-cure method was adopted to apply the prepared nano-formulation on the fabric. The parameters such as curing time, temperature and crosslinking agents were optimized to achieve the better add-on%. The presence of formulation on the fabric was confirmed by Coomassie Brilliant Blue staining method. Some of the characterization studies such as FE-SEM, EDX and cytotoxicity studies were performed for the vitamin E nano-formulation finished fabric.

The durability of the vitamin E finishes on the fabric was evaluated by HPLC. The vitamin E finishes were durable up to 10 washes. Franz diffusion apparatus was used for in vitro release studies. The diffusion cells were thermo regulated with a water jacket at 37 ℃. The in vitro release profile (15.3 % at 24 hours) was evaluated at different time intervals. The in vivo permeation study (12.8% at 24 hours) was performed using Wistar rats and plasma sample was analyzed by HPLC to quantify vitamin E in the plasma permeated through skin epidermis layer.

Recognitions to SITRA

SITRA is now a medical devices testing laboratory recognised by CDSCO

SITRA has obtained approval as a Medical Device Testing Laboratory from the Central Drugs Standard Control Organization (CDSCO), marking a significant achievement for the organization in the past year. This approval encompasses testing capabilities for 28 medical textile products and 2 test methods, covering a wide range of medical device classes including Class A, Class B, and Class C. These product categories include Personal Protective Equipment (PPE) and also would dressings, stockings, among others. The approval form CDSCO is a distinction that only a handful of laboratories in India have achieved.

SITRA is now
An empanelled laboratory to test medical textile products under QC orders

SITRA has also been empanelled by the Bureau of Indian Standards (BIS) for testing textile and medical textile products covered under quality control orders, as well as water samples. Medical textile products not regulated by CDSCO are governed through Quality Control Orders (QCO), fro example, sanitary napkins, diapers, bed sheets, pillow covers, staple yarn, etc. SITRA is one among the laboratories in India supporting BIS in ensuring the quality of products through its testing.

With these approvals, SITRA is well-positioned to assist medical textile manufacturers in ensuring the safety, efficacy, and quality of their products. This assistance extends not only during the manufacturing process but also during post-market surveillance, thereby fulfilling regulatory requirements in India. Overall, SITRA's role is pivotal in safeguarding public health by ensuring that medical devices adhere to stringent quality, safety, and efficacy standards before they are made available to healthcare providers, patients, and the public in India.

New instruments installed at SITRA

Multimode Microplate Reader in CoE-Medical Textiles

The Tecan Infinite 200 Pro model of multimode microplate reader is a monochromator-based system that covers a range from 230-1000 nm Abs. This instrument is used in various research and quality evaluation of medical / technical textile products. The instrument has capability to analyse 96 samples for the below listed tests within 2 minutes.

- § Antimicrobial activity
- § Microbial growth
- § Reporter gene assays
- § Cell viability
- § Cytotoxicity
- § Enzyme kinetics
- § Anticancer activity
- § Cellular uptake and transport studies
- § Fluorescent assays
- § Luminescence assays

Industry as well as researchers would find this useful to test their samples using the above instrument.

UT6 in SITRA's Textile Physics Yarn Laboratory

A new Uster Tester 6, current generation evenness tester from USTER Technologies has been installed at the Textile Physics Division of SITRA. Testing of samples in this UT6 instrument was initiated from 2nd week of September, 2023. Some mills have started using this instrument for testing their samples.

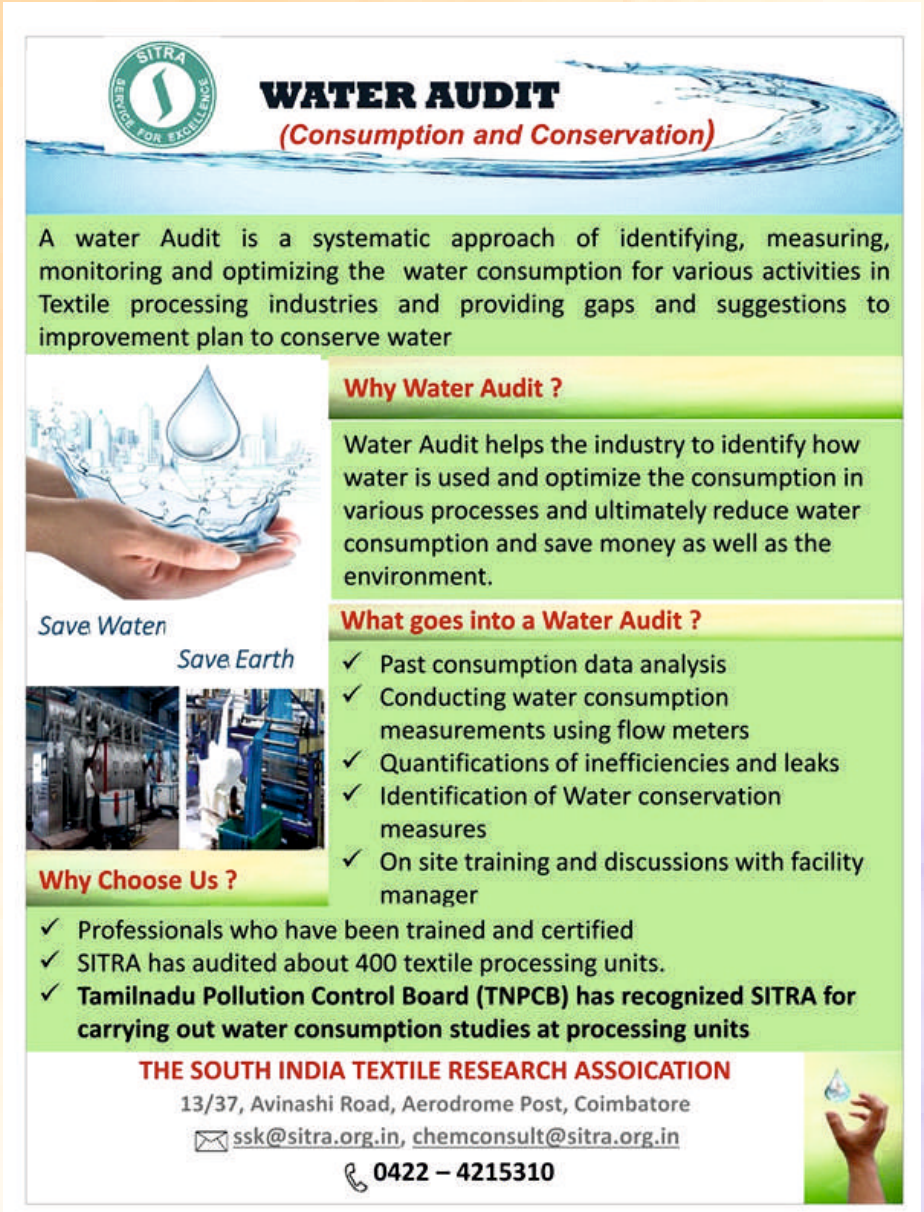
The various modules available on the UT6 instrument installed at SITRA are detailed in the table given below.

SITRA invites all spinning mills to utilize the instrument for testing their samples.

Sensor Module	Application Area
Sensor CS	Measurement of yarn unevenness and imperfections at a maximum test speed of 800 mpm. The higher test speed minimizes the testing time and increases the number of samples per day. So that mills can obtain the test results of the sample quicker.
Sensor OH	Hairiness measuring unit.
Sensor HL	**Hairiness length measuring unit:** Assessment of the raised hairs that indicate the pilling potential of the fabrics made from the tested yarn especially in knitted fabrics
Sensor OM (Multifunctional Measuring unit)	**Appearance parameters:** Measurement of yarn diameter, shape, density and diameter variation of staple fibres yarns. **Twist:** Identify the level of yarn twist and twist variation for 100% CO, PES, CV, CMD, CLY and their blends, carded and combed for

Water consumption audits

Textile Processing industries are the largest water consumers in India. Tamil Nadu Pollution Control Board (TNPCB) has recognized SITRA's textile chemistry department for carrying out water consumption studies at processing units. The actual consumption of water and process time can be identified by the industries through the water consumption audits. It leads to optimization of the process and the parameters. SITRA has audited about 52 dyeing units last year and previously around 400 dyeing units. The audit report helps units to apply to TNPCB for an increase in its production capacity and the consent quantity of water.



Seminars and Conferences

Meditex 2023

SITRA, in collaboration with MFI India, organized the 3rd edition of Meditex druing 12th Sep to 14th Sep. 2023 at Jio World Convention Centre, Mumbai. The event featured an exhibition stall and an International Conference on Medical Textiles. Sixteen manufacturers representing various segments of medical textiles showcased their products at the dedicated Meditex pavilion. An International Conference on the Scope and Opportunities in Medical Textiles was held on 13th September with the support from the Ministry of Textiles, Government of India.

The conference featured speakers from prestigious international and National institutions such as NCSU, USA, National University of Singapore, IIT and renowned hospitals. Notably, a book of "15 years of Research In Medical Textiles" was unveiled during the conference. Smt Darshana Vikram Jardosh, Hon'ble Minister of State for Textiles & Railways, emphasized innovation, commercialization, and collaboration between research organizations, academia and industries. She lauded India's transformation into a global leader in PPE production during the COVID-19 pandemic and urged support for startups in medical textiles. The government's initiatives, such as the PLI Scheme for Textiles and National Technical Textiles Mission, were highlighted.

15 Years of Research in Medical Textiles" Book launch event during the conference

Shri. Rajeev Saxena, delivering the keynote address

Shri. Rajeev Saxena, Joint Secretary, Ministry of Textiles, stressed the growing importance of medical textiles, calling for increased innovation, research, and repositioning of focus. The Ministry of Textiles is working on regulatory aspects and plans to notify Quality Control Orders for medical textile items.

Dr. Shailesh Pawar, Scientist F, ICMR-NIV, highlighted the indigenous potential in medical equipment development, emphasizing the role of medical textiles in health emergencies. The need for innovation in bio-degradability for sustainability was underscored, and industry appreciation for government initiatives was expressed by Shri S K Sundararaman, Deputy Chairman, SIMA and Member of Council of Administration, SITRA.

Dr. Shailesh Pawar, Scientist F, NIV, delivering the opening remarks

Seminars and Conferences

The conference encompassed diverse technical sessions, covering topics like the prospects of medical textiles, import substitution, entrepreneurial pathways, future directions, and standards in the field. Entrepreneurs who have excelled in the field of medical textiles shared their journey to inspire young entrepreneurs. The conference was attended by approximately 140 individuals including manufacturers and entrepreneurs from various segments of the medical textiles industry, providing them with valuable insights and networking opportunities.

Dr.S.K.Sundararaman, delivering the

He highlighted the role played by the Ministry in guiding the industry and the institutes for technical textiles development and also organizing such conferences that facilitate the exchange of knowledge and propel the industry toward higher levels of value addition. He also praised SITRA for its leading role in advocacy, research, testing, and certification in the field of medical textiles.

Two sessions were held on different topics to highlight the issues in medical textiles. **The first session was on "Recent Advances and Prospects in Medical Textile Industry".** It was chaired by Prof. Seeram Ramakrishna, National University of Singapore, Singapore. The cutting-edge developments in the field of medical textiles were highlighted during the session. **Professor Asim Tewari** delivered an extensive overview of the advancements and innovations in the field of medical and smart textiles. He emphasized the critical need for engineers and domain experts who possess a thorough understanding of textile fibre functionality in technical textiles. He addressed the challenges and opportunities associated with tailoring medical textiles to nano and micro scales, highlighting the importance of scaling down these materials. Furthermore, he drew attention to the manufacturing technologies, such as the Composite Manufacturing Facility and Post-Processing Facility, employed in fabricating structural textiles

The presentation also featured technical textile products and prototypes, including a diabetic foot product designed to prevent ulcers, bulletproof jackets, electrically conductive geotextiles, hydrogen cylinders using textile compositesand hybrid composite body armour.

Prof. Martin W. King conducted an in-depth exploration into the various stages of research related to barbed sutures. He underscored the significance of barbed sutures possessing characteristics like knotlessness and self-anchoring capabilities. He delved into the advanced fabrication techniques for creating barbed sutures, encompassing mechanical barbing and laser ablation techniques.

Seminars and Conferences

Dr. A. Shanmugavasan provided a thorough explanation regarding the imperative for our country's self-sufficiency in medical textiles in the near future. He elaborated on how our nation is on track to achieve global healthcare benchmarks by 2035, with our current healthcare expenditure evenly split between public and private sectors, and both expected to rise. He also underscored the potential boost in private investments due to Foreign Direct Investment (FDI) in the health sector. He motivated the attendees in the field of medical textiles by sharing success stories and elucidated the value spectrum within the medical textiles market, spanning from low-value, high-consumption, less complex healthcare and hygiene textiles to high-value, low-consumption, intricate implantable and extracorporeal devices production in India. He expounded on the importance of fostering domestic production across various product categories.

Session 2 was in the area of "Future Direction of Medical Textiles" and was chaired by Prof. Martin W. King, North Carolina State University, USA. Prof. Kind provided his initial comments by providing valuable insights into the exciting and transformative path ahead for the medical textiles industry. **Ms. Celine Moreira** underscored the importance of innovating sustainable polymers, especially in light of tightening regulations regarding microplastics release during product end-of-life. She elaborated how they are attempting to implement a unique biotransformation technology, a time-controlled process activated by sunlight, heat, air, and moisture. The technology seamlessly **integrates into normal mechanical recycling processes, without compromising the mechanical and optical characteristics of recycled products within the standard supply chain. Prof. Seeram Ramakrishna** delved into the pivotal role played by nanotechnology and artificial intelligence (AI) within the field of medical textiles. His discourse provided an intricate examination of how AI and nanotechnology are reshaping the landscape of medical textiles, ushering in novel applications and driving improvements in patient care. He highlighted the significance of AI-based algorithms in the domain of biomedical engineering with a focus on polysaccharides (PSA), known for their medical safety and responsiveness to stimuli. He underscored the potential for fully automated clinical practices with AI intervention, paving the way for efficient healthcare delivery with reduced manpower requirements. The integration of nanotechnology and AI-assisted systems, coupled with the Internet of Medical Things (IoMT) technology, was identified as a critical component in the development of innovative healthcare solutions, including nanomedicine and nanorobotics. The incorporation of advanced two-dimensional (2D) functional materials like graphene, borophene, and MXenes has further expanded the possibilities, leading to the creation of next-generation bio-sensing devices and smart bandages capable of monitoring wounds and providing targeted treatment.

Mr.Douglas McKee Benton in his virtual presentation underscored Ahlstrom's commitment to sustainability in the production of medical textiles, encompassing various aspects such as the use of eco-friendly raw materials and

strategies to reduce emissions. He added that Ahlstrom played a pivotal role in advancing the shift towards a circular economy and a more sustainable world by implementing high-emission reduction strategies through the technology.

Dr. Juan Hinestroza, Cornell University, USA delivered a virtual presentation on the interplay between nanomaterials, nanoscale phenomena, and their utilization in the field of medical textiles. He highlighted the significant distinctions between textiles and nanotechnology, exploring into various factors. He discussed the modification of natural fiber surfaces using nanomaterials, presenting a study on depositing diverse nanoparticles like gold and silver onto cotton surfaces through atomic layer deposition. The presentation included insights into removing pollutants from water using Metallic Organic Frameworks (MOF) structures grown on cotton. Another application involved cotton coated with hydrogel and chitosan for detecting pH and lactate concentration in sweat. He discussed how cotton fibers and yarns could be coated with chitosan and graphene oxide to create sensors capable of detecting urea and glucose levels in sweat. Finally, he concluded by explaining the development of a cotton thread-based wearable non-invasive biosensor capable of simultaneously diagnosing diabetes and kidney failure.

The sessions were followed by 3 panel discussions. The first was on the topic of **"Import substitute: Scope and demand of indigenous medical textile products".** The panel was moderated by Shri. Sumit Marwah, Director, Dispoline India pvt. Ltd, Bangalore and deliberators included Dr. Kapil Pawar, Orthopedic Surgeon, KEM hospital, Mumbai; Dr. Michael Rodrigues, Co-Founder and Head - R&D, CareNow Medical Pvt. Ltd, Coimbatore and Dr. E. Santhini, Head I/C, CoE Medical Textiles, SITRA. The session underscored the significance of import substitution in the realm of medical textile products, examining current imports and opportunities for domestic production. It also addressed the high demand for indigenous solutions in India and showcased successful examples of locally developed alternatives to imported products. The panelists emphasized the pivotal role of research and product development in the import substitution sector, highlighting how it strengthens a nation's healthcare system by ensuring a consistent supply of vital medical devices during critical times.

The second panel discussion was on the topic**, "Entrepreneurial pathways in Medical Textiles – from concept to market"** which was moderated by Shri. Kamal Johari, Managing Director, Nobel Hygiene Pvt. Ltd., Mumbai and deliberated by Shri. Amit Kudav, Assistant Vice President, Venus safety and health Pvt. Ltd, Mumbai; Shri. T. Karthik, Director, Real relief India Private Ltd., Tamil Nadu; Ms. Shivani Swamy, Global Sales and Business Development, Livinguard Technologies, Mumbai.and Dr. Michael Rodrigues, Co-Founder and Head – R&D, CareNow Medical Pvt. ltd., Coimbatore. The session highlighted the entrepreneurial journey of the industries from conception of ideas into tangible reality. The moderator and panellists shared their experience in bringing their concepts to products until they are available in the market. The discussions put forth the pprioritization of patenting by entrepreneurs to safeguard against infringement and duplication of their products and technologies, the growing environmental consciousness among people which is creating opportunities for reusable products and biodegradable materials expected to dominate the hygiene product market in the coming years.

The third panel discussion was on the topic**, "Standards, Certification and Regulatory Requirements"** which was moderated by Dr.Anup Rakshit, Executive Director, ITTA, Mumbai and deliberated by Shri. Aseem Sahu, Deputy Drug Controller, CDSCO, New Delhi; Shri. Dharmbeer Yadav, Joint Director, BIS, New Delhi' Dr.Sanjeev Relan, CEO, Shalex Meditech, Andhra Pradesh and Shri. Kulveen Singh Bali, Quality Compliance (Asia) – 3M Health Care, Bengaluru. The session emphasized the significance of standards, certifications and regulations for medical textile products. The panelists elucidated the BIS certification process, underscored the importance of obtaining CDSCO licenses, and discussed the challenges encountered by manufacturing industries along with potential solutions. The discussion highlighted how safety and quality of medical textile products are paramount, impacting both patients and healthcare professionals and hence are regulated by the CDSCO. The importance of obtaining a CDSCO license for manufacturing was highlighted.

Training Programmes

Training Programme on "Functional Skills for Efficacious performance"

The programme was conceived to dwell on some of the essential technical aspects that supervisory personnel need to possess for effective day to day functioning in spinning mills. Skills acquired through understanding of these areas would empower middle level management personnel with competency in the critical areas of production, quality and maintenance. Thirty eight participnts attended the programme which was held during 21 –23 September, 2023.

Training programmes on "Implementation of ISO/IEC 17025:2017 and internal auditing"

A 4-day training programme for the technicians working in quality control / testing laboratories, merchandisers, exporters, etc., was conducted during 10 – 13 th July, 2023. Totally 31 participants attended this programme which covered topics like implementation and internal auditing in a laboratory environment based on the requirements of ISO/IEC 17025:2017 standard, a verview of the structure of ISO 17025 :2017 standard, Process-based approach of the Standard, PDCA process with risk/opportunities identification and mitigation, verification and validation decision rules principles of impartiality organizational and management structure, personnel and measurement resources (competence, facilities, and equipment), management of audit programmes and audit planning and preparation Complaints handling.

Technical Awareness programme

At the request of M/s. Tommy Hilfiger, Bangalore., SITRA conducted a three day training programme on foundation of textile testing, for their executives to dwell on topics like fiber properties and its assessment, yarn numbering, yarn properties, woven properties, knitted properties chemical processing and Fabric defects. Five executives of the company attended the three day programme held during 26 -28 September 2023.

Training Programme on "Weak Spot Analysis"

At the request from member Mill M/s. **Sri Kannapiran Mills, Coimbatore** SITRA conducted a one day training programme on "**Weak Spot Analysis"** for their Staff members. Topics covered in the programme included Yarn Strength – Assessment and Interpretation, Weak Spot DR, etc. Ten executives attended the programme which was held on 11 May, 2023.

Training Programme on Defect Analysis - Woven & Knitted Fabric"

At the request from member mill M/s. Voltas Ltd., Coimbatore SITRA conducted a two day training programme on Defect analysis in Woven & Knitted Fabrics. The topics coverd in the programme included types of defects and their mode of occurrence, causes and remedies for defects in yarn and fabrics and case studies of defects in Industry. Eight participnts attended the programme which was held during 7 – 9 August, 2023.

Training programme for Trainers

At the request from M/s. NSL Textiles Ltd, Edlapadu and Inkollu units. SITRA conducted a seven-day training programme for their trainers and staff. Topics covered in the training included material handling, waste reduction and

quality improvement, house keeping, absenteeism, ethics at work place, safety measures, right work methods, dos and don'ts on the job, importance of productivity, like scientific selection, performance appraisal and record maintenance of workers. Eighty participants attended the programme which was held 3 to9rd February, 2023.

Similar programmes covering indentical topics were held for the following mills:

- M/s. NSL textiles Ltd. Veeravalli unit, Andra Pradesh during 25th to 29th July, 2023 wherein 40 trainers participated.
- M/s. Chenab Textiles, Jammu during 23td to 27th November, 2023 Wherein 35 trainers attended.

Skill Development Programme

The PMKVY scheme initiated by the Ministry of skill development and entrepreneurship, Govt. of India, is a scheme that aims to leverage the strength of institutions like SITRA for enhancing capabilities for skill development in the industry. Being a training parter of textile skill council, SITRA has trained under the scheme 16 operatives from a couple of member mills for a period of 38 days in tenting jobs in Ring frame. The programmes were conducted in Tamil and Hindi.

Pre-employment training and retraining programmes for textile workers

One out-station and one local mill availed SITRA's training services for training their workers in testing jobs. Forty three operatives in spinning and open end spinning departments were trained in 2 batches. The training programmes were conducted in Tamil.

Consultancy studies on machine audit

SITRA has been offering services in the areas of machinery audit of spinning mills. Many mills, including high tech mills from Tamil Nadu, Maharashtra, Rajasthan, Gujarat Andhra Pradesh have availed these services.

In order to enable the mills to upkeep the machinery in good condition SITRA has designed a unique service package to mills which would deal with the following aspects.

- Analysis of machinery condition
- Maintenance records
- Maintenance work methods & house keeping
- Maintenance Schedules and its frequency
- Use of proper tools and lubricants

SITRA would levy a nominal fee for the above study. Last year, many mills availed this service. For further information in this regard, the mill may contact

SITRA Spinning Division, Phone no. 0422 4215347,345,333
E-mail.: spg@sitra.org.in; nkn@sitra.org.in;

Visitors

- **Mr Torben**, Real Relief Anti microbial Sanitary Napkin, Denmark
- **H.E.Mr. Shelley Salehin**, Deputy High Commissioner of Bangladesh.
- **Dr. Engr. Abu Bakr Siddique**, Dean of FTE and FAS, BGMEA University of Fashion & Technology (BUFT), Bangladesh.

CONSULTANCIES OFFERED BY SITRA

S. no.	Nature of consultancy service	No. of services offered
1.	Water consumption and time study of soft flow / Yarn dyeing machines	52
2.	Inspection work of Railways	15
3.	Monthly inter-mill sureveys	12
4.	Air compressor study.	10
5.	Energy audit.	9
6.	Annual consultancy service	7
7.	Assessment of laboratories for NABL accreditation purpose	5
8.	Work assignment study / Man power audit	5
9.	Machinery valuation	4
10.	Machine Audit	4
11.	Technical consultancy visit	4
12.	NABL internal audit and consultancy for NABL	2
13.	Maintenance audit	2
14.	Modernization study	2
15.	Sound Level study	1
16.	Process stock validation	1
17.	New product development	1
18.	Humidification Plant study	1
19.	Yarn realization study	1
20.	Functional skill training program	1
21.	Yarn costing study	1
22.	Costing study	1
23.	Assessment of 32 spinning, weaving & processing Assessors	1

Besides the above consultancy studies, SITRA has made 93 liaison visits to mills, solved 13 adhoc problems regarding UKG conversion factors, attended 11 Technical trouble shootings, tested 2197 accessory samples and also calibrated 17188 instruments.

Textile Titbits

Coats develops threads with HeiQ's Viroblock technology - By Jessica Owen, August 2020, WTIN

Coats, the world's leading industrial thread company, is partnering with HeiQ, a Swiss technology company, to incorporate HeiQ Viroblock technology into its engineered yarns. The agreement also gives Coats exclusive global access to the technology for use in sewing threads.

HeiQ Viroblock is among the first textile technologies in the world to be proven effective in laboratory testing against SARS-CoV-2, the virus from the coronavirus family that causes Covid-19. It has been shown to be 99.99% effective in 30 minutes in tests conducted with the Peter Doherty Institute for Infection and Immunity in Melbourne, Australia.

The Coats Innovation Hub – America in North Carolina, US, is adapting HeiQ Viroblock technology to create a new range of threads and engineered yarns suitable for application across a wide range of end-use products. Non-toxic and hypoallergenic, HeiQ Viroblock merges micro silver technology to attract virus particles, which then combine with vesicle technology to break down the viral membrane within seconds. The micro silver technology uses recycled silver to enhance its sustainable offering, while the vesicle technology is biobased. It is even possible for every stitch holding the fabric together to deliver the same effect, leaving no chance to harmful micro organisms.

Innovative recycling of polyester with salt

Polyester is the most widely used textile fibre in the world, with an annual production of around 60 million tons. It is not biodegradable and can be a hazard to the environment; especially blended fabrics like polycotton are difficult for the industry to separate, and therefore recycle. Recycling polyester poses a significant challenge, particularly in separating the polyester and cotton fibres that the blend fabric is made of without losing either of them in the process Conventional recycling methods prioritize preserving the plastic component, resulting in loss of cotton fibres. Moreover, these methods are costly, complex and generate metal waste due to the use of metal catalysts which can be cytotoxic and contaminate the process.

A group of chemists from the University of Copenhagen, Denmark, have invented a green and innovative solution using a single household ingredient. In the process, the **Hartshorn salt**, also called ammonium bicarbonate is broken down into ammonia, CO_2, and water. The combination of ammonia and CO_2 acts as a catalyst, triggering a selective depolymerization reaction that breaks down the polyester while preserving the cotton fibres. Although ammonia is toxic in isolation, when combined with CO_2, it becomes both environment friendly and safe for use. Due to the mild nature of the chemicals involved, the cotton fibres remain intact and in excellent condition.

Previously, the same research group demonstrated that CO_2, could serve as a catalyst for breaking down polyamide, among other things, without leaving any trace. This discovery inspired them to explore the use of Hartshorn salt. Nevertheless, the researchers were pleasantly surprised when their simple recipe yielded successful results, e.g. a polyester dress has been cut into small pieces and placed in a container. Then a bit of mild solvent and thereafter Hartshorn was added and heated upto 160°C and left for 24 hr. The result is a liquid in which the plastic and cotton fibres settle into distinct layers. This is a simple and cost-effective process.

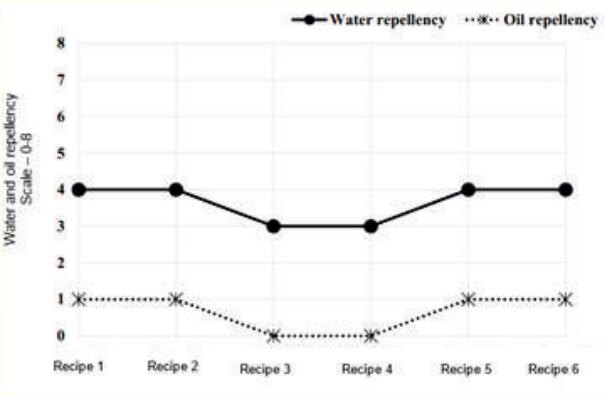
While the method has only been tested at the laboratory level thus far, the researchers point to its scalability and are now in contact with companies to test the method on an industrial scale.

Source:https://www.textiletechnology.net/fibers/news/university-of-copenhagen-innovative-recycling-process-of-polyester-with-salt-34514

DEVELOPMENT OF BIO AND NON-FLUORINATED PALMITIC ACID BASED WATER REPELLENT FOR COTTON FABRIC

Rabia S, Muhammad M, Naveed R ,Shaheen S,Syed W ॐWahla A, Journal of Natural Fibers, 2022, Vol.19(13), pp.5637-5650.

Cotton is widely used in fabric manufacturing due to its excellent properties. However, its property of hydrophilicity limits its use in certain end products. For instance, the high absorbance property of cotton fibers results in the low oil and water repellency. Oil- and water-repelling clothes are required in many situations such as safety against rain and oil exposures. Textile industry uses many types of oil and water-repelling agents such as hydrocarbons, silicones and fluorinated compounds. Hydrocarbons such as paraffin, exhibit good water repellence but exhibit poor oil repellency. Silicone based repellents have various issues such as poor oil repellency and harmful wastewater. However, fluorinated compounds provide higher level of protection against oil and water but are dangerous to human health and environment due to presence of fluorine.



This article focuses on the synthesis of bio-based and non-fluorinated oil and water repellent recipes for the cotton fabric through the polymerization of palmitic acid with an eco-friendly cross-linker "citric acid" considering the effects of catalyst, enhancer, time, temperature and polymerization environment. Palmitic acid is a bio-based, saturated fatty acid with 16 carbon atoms and can be obtained easily from the numerous sources such as plants.

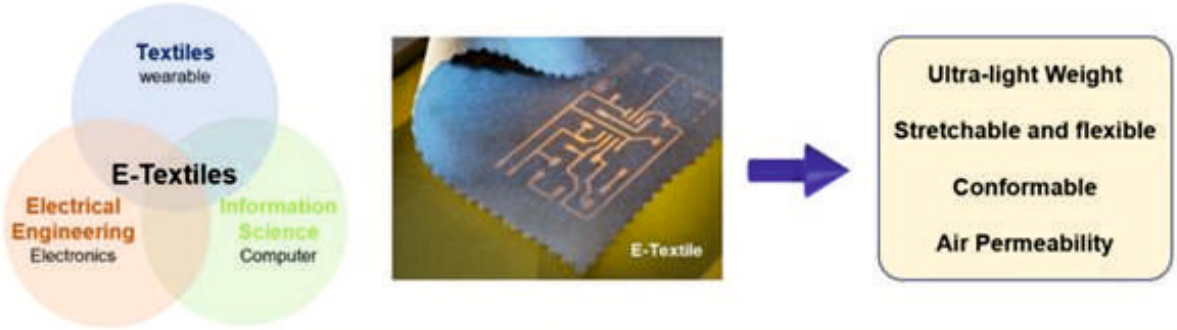
The authors had developed six different recipes based on various polymerisation techniques and found that they had a water repellency rating of 70, contact angle of 145°, and stain release rating of 4. They also observed that the air permeability retention, crease recovery angle, shrinkage control and anti-microbial performance of the newly developed oil and water repellent fabric was better than the C6-based fluorocarbon. Thus, eliminating the use of fluorinated compounds which are dangerous for human health and the natural environment.

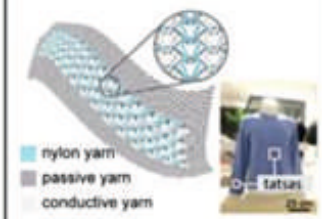
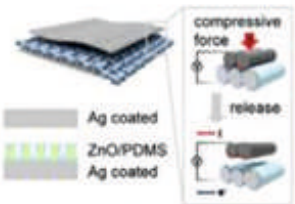
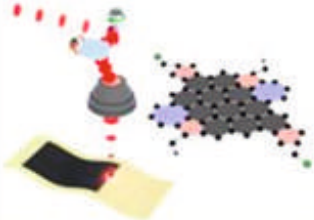
MULTIMODAL E-TEXTILE ENABLED BY ONE-STEP MASKLESS PATTERNING OF FEMTOSECOND-LASER-INDUCED GRAPHENE ON NONWOVEN, KNIT, AND WOVEN TEXTILES

Dongwook Yang, Han Ku Nam, Truong-Son Dinh Le, Younggeun Lee, Young-Ryeul Kim, Seung-Woo Kim, Hak-Jong Choi, Seunghwa Ryu, Soongeun Kwon, Young-Jin Kim, Journal of ACS Nano 2023, 17, 19, 18893–18904

Personal wearable devices are considered important in advanced healthcare, military, and sports applications. Among them, e-textiles are the best candidates because of their intrinsic conformability without any additional device installation. However, e-textile manufacturing to date has a high process complexity and low design flexibility. Authors report about direct laser writing of e-textiles by converting raw Kevlar textiles to electrically conductive laser-induced graphene (LIG) via femtosecond laser pulses in ambient air. The resulting LIG is reported to have high electrical conductivity and chemical reliability with a low sheet resistance of 2.86 Ω/. Wearable multimodal e-textile sensors and supercapacitors are realized on different types of Kevlar textiles, including nonwoven, knit, and woven structures, by considering their structural textile characteristics. The nonwoven textile is reported to exhibit high mechanical stability, making it suitable for applications in temperature

sensors and micro-supercapacitors. On the other hand, the knit textile possesses inherent spring-like stretchability, enabling their use in the fabrication of strain sensors for human motion detection. Additionally, the woven textile is said to offer special sensitive pressure-sensing networks between the warp and weft parts, making it suitable for the fabrication of bending sensors used in detecting human voices. The authors hope that the direct laser synthesis of arbitrarily patterned LIGs from various textile structures could result in the facile realization of wearable electronic sensors and energy storage.



	Conductive Fiber Weaving	Printing	LIG Patterning
Scheme			
Design Flexibility	Mid	Mid	High
Process Complexity	High	Mid	Low

Staff News

Meetings Attended

Dr. Prakash Vasudevan, Director, SITRA attended the following meetings:

- 15th Project Appraisal and Monitoring Committee (PAMC) meeting, 8th February, 2023.
- 3rd Global Textile Conclave, Hotel Marriot, Jaipur, 15th to 17th March, 2023
- 32nd Meeting of the Textile Sector Skill Council, Hotel Marriot, Jaipur, 15th March, 2023
- BIS Meeting at National Institute of Training for Standardization (NITS) , Noida, New Delhi, 12th May, 2023
- Meeting with Mr.D.P.Yadav, IAS, Principal Secretary (Handlooms, Handicrafts, Textiles & Khadi) 29th May, 2023
- Interaction of TRAs under the Chairmanship of Shri Rajeev Saxena, Joint Secretary at MoT, Udyog Bhawan, New Delhi, 19th June, 2023.
- Review of TRAs under the Chairmanship of Shri Rajeev Saxena, Joint Secretary at MoT, Udyog Bhawan, Delhi, 05th October, 2023.
- CII Conference on Technical Textiles, which is scheduled on 17 November 2023 at Hotel Le Merdien, Coimbatore, 17th to 19th November, 2023.

Research publications

D.Jayaraman, S.Balamurugan and N.K.Nagarajan "Effect of Sliver compactness on winding clearer cuts in 100% polyester yarn – A case study", Spinning Textiles – Sept.-October 2023.

E. Santhini Antimicrobial textiles: A boon or a bane?, Indian Textile Journal, Nov 2023, 74-75.

R Radhai, S Sivakumar and E Santhini, Sustainable medical textiles: A way forward, Indian Textile Journal, May 2023, 74-75.

SITRA - CoE-Medical Textiles released a book "15 Years of Research in Medical Textiles, A Crystal Jubilee Publication (2008-2023)" during Meditex 2023 conference held on 13th September, 2023 at JWCC, Mumbai.

Papers presented / Lectures delivered

- SITRA scientists presented the following 5 papers at 61st Joint Technological Conference on 14th and 15th December, 2023 organized by The Bombay Textile Research Association (BTRA):

  1. Antioxidant cosmetotextiles - Durable Nano-encapsulated Vitamin E finishes on textile fabrics and its controlled release study - ***Dr. N.Sudhapriya & S.Sivakumar***
  2. "Study on lint content in blow room lines" - ***N.K.Nagarajan***
  3. "Effect of short fibre content (SFC) in raw material on lint shedding propensity of conventional and compact yarns"- ***V.Vijayajothi & N.K.Nagarajan***
  4. A comparative study on the quality of airjet and ring supn yarn made from cotton - ***Dr.V.Thanabal***
  5. "Design and development of facile high throughput needle less electrospinning set up" - ***Dr.L. Amalorpava Mary***

- **S. Sivakumar**, presented a paper titled "Sustainable Solutions for Textiles" at the Pulcra customer meet organised by Pulcra Chemicals, India.
- **N.K.Nagarajan**, presented a paper on "Quality Management" at Lakshmi Machine Works Ltd., held on 7th August, 2023.