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Contents

Editorial:
A beginning of Advancements towards excellence - 2020
by Prof. (Dr.) Ravindra V. Advirekar

Aal Dyeing - Past and Present
by Amita Dutta, Deepali Singhee & Sankar Roy Maulik

Functionalization of Antibacterial and UV Protection
Properties in Cotton Fabric Dyed with Terminalia
Arjuna Bark Extract
by Lalit Jajpura & Abhilasha Rangi

Preparation of Silk Fibroin / PVA Hydrogels Using
Chemicalfree Cross-Linking for Tissue Engineering Applications
by Pallavi Vishwas Madiwale, Girendra Pal Singh,
Santosh Biranje & R.V. Advirekar

Graphene-based Cotton fabric for Multi-functional Finishing
by Saaptarshi Maiti & Ravindra V. Advirekar

Texperience
Inventory - a Tool for Productivity
by Mr. R. N. yadav

Texnotes - Chapter 16
GRAPHENE A WONDER MATERIAL: CO, Sensing
by Saaptarshi Maiti, Pintu Pandit, Geetals Mahajan,
R. V. Advirekar & M. D. Teli

OTHER FEATURES
Advertisement Index
Unit Activity
News
Forthcoming Events
Editorial

A beginning of Advancements towards excellence - 2020

Textile industry is one of the oldest industries in India and is essentially linked to a range of traditions and cultures that is a reflection of the diversity prevailing to our country. This industry has a wide range of segments under its umbrella. The textile sector particularly begins with fibre processing to garment manufacturing with ever existing and increasing bottle neck of chemical processing in the light of growing need of sustainability and circularity. In today’s era where every branch of science and technology are upgrading to advanced technology, textile is also not at the back stage. We have witnessed textile industry embracing wholeheartedly incoming technologies and concepts like Machine learning, robotics, artificial intelligence, 4R’s, IOT, Textile 4.0, startups, made in India etc. Textile Association of India (TAI) which celebrated its 80th Anniversary last year is on the forefront with its all units in organizing various conferences, workshops, panel discussion to create awareness and help industry in every possible way. TAI is undoubtedly providing leadership to giant textile industry in India connecting every stake holder; manufacturer, user, government, academia, traders and allied industries to textiles. I congratulate all the members of TAI for their active interest for well being of Indian Textile Industry.

Over the years we are witnessing the gradual shift from traditional textiles to advanced textiles popularly known as technical textiles. Technical textile is one of the segments of this industry that has gained significant attention all over the world. These textiles have applications in multiple areas of economic activity, such as aerospace, shipping, sports, agriculture, defense and health care, etc. Not only textile but all industries are looking for advanced materials to bring in longevity, lightness, energy efficiency attributes for greater sustainability. The world’s first two-dimensional material graphene could be the biggest contributor as advanced material to almost all industries and also to the technical textile sector. Due to its diverse properties, it lends itself to a multitude of applications from composites and coatings, water filtration, sensors, electronics and biomedical applications. In textile industry it has just started getting exploited in the advancement of wearable technology. The series of chapters under caption TEXNOTES is being incessantly reaching the readers...
of this bi-monthly journal since last 3 years has attempted to throw some insights upon such wonder material Graphene. The authors of the series have already contributed seventeen chapters and three more are yet to come in the upcoming issues to complete the series. Hopefully, through such series the authors would have been able to make the readers to ponder upon such wonder material and to incorporate its technology for the advancements in textiles both in the academia as well as the industry.

With this backdrop it is also evident that the well established sectors of textile value chain like spinning, weaving and to certain extent chemical processing is finding decline in research and innovation and commensurate decline in its paper publication. We at JTA are making every effort to keep our readers abreast about the latest research and trends in the field and will keep on doing our best. On this note, on behalf of TAI and JTA, I take this opportunity to say that may this New Year "Twenty-Twenty" be year of advancements on all fronts may it be personal or professional life with more and more feasible innovations again on all fronts with inclusion of textiles.

So "Wish you all a very Happy and Prosperous New Year-2020"!!

Prof. (Dr.) R. V. Adivarekar,
JTA, Editor
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Aal Dyeing - Past and Present

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² Visva-Bharati University, Department of Silpa-Sadana, Sriniketan

Abstract
India is renowned for the wide variety and excellence in her use of natural dyes in textiles. Aal is one such dye which is used almost in all parts of India for achieving red colour due to its abundant presence. However, the use of synthetic dyes is responsible for declining the use of Aal dye. The process of dyeing as well as its preparation before dyeing varies from place to place. The tribal (Mirgan) community of Kotpad, Koraput in Odisha still uses Aal root barks to dye their unprocessed cotton yarn and weave hand woven cotton textiles.

Keywords
Aal, Castor oil, Dung, Tribes

1. Introduction
Man has always been fascinated by the abundance of colour in nature and the stains from juices of leaves, fruits, flowers, roots and barks have inspired them to decorate the fabric [1]. The use of natural dyes for dyeing textile materials had become a part of very ancient life style of our country. One can probably trace the history of Indian 'dyes' to the time of Mohenjo-Daro (c. 3000 B.C.) and the chemical examinations of the fabric believed to be from Mohenjo-Daro, suggests the use of Madder i.e. Rubia cordifolia for the colouring purpose [2]. India has been known as the world's largest dye-producing country with unlimited variations of dyes having excellent quality from times immemorial[1]. The colouring of textiles was given a lot of importance in India and the art of dyeing excelled. The preparatory processes involved before dyeing were also given same degree of importance as that of actual dyeing and weaving process. The Indian craftsman's knowledge of the technology of dyeing of textiles remained a closely guarded secret for a long time and India had a virtual monopoly in the production of dyed, painted and printed textiles with natural dyes [3]. Amongst the naturally occurring dyes, the red shade obtained from roots of Madder, extensively grown in Europe, Middle East and Asia was considered very important [4]. Aal (Morinda citrifolia, Morinda tinctoria, Morinda multiflora, Morinda persicaefolia and Morinda augustifolia) [5] is easily available in major parts of the country and extensively used to dye textiles in red shade. The dye yielded from Aal is not as rich as that from Madder. Aal is also known as ack, ach, acchu, surangi, sorangi and kunaka in various parts of Rajasthan, Gujarat and Maharashtra and asauch, ach, achoo, aooosh, ashkari, challi, chalu, chili, hardi, darudaridra, malancba, barketari, kat, kasotta, mallika in Bihar, Orissa and the then Bengal. The colouring matter present is more in the root than in any other parts [5].

2. Aal dyeing processes in ancient India
The red colour developed in the Marwar district of Rajasthan with Aal is called Chol and in some places the use of metals and the dye yielding parts has also not been reported [5]. In Surat and Ahmadabad red colour is mostly developed with Aal. In various regions of Bihar, Orissa and Bengal, Morinda tinctoria popularly known as rang-gachare is used for producing red colour. It gives reddish brown colour on cotton [5]. In Darbhanga of Bihar, the roots, bark and twigs were called gintonan, chhar and power respectively. The colours obtained vary from reddish yellow to pink and also various shades of red to dark brownish red [5].

2.1 Preparatory processes
Preparatory process involves the use of oil and dung. The most usual process is to steep the yarn for two to six days in a mixture of powdered castor oil seeds or castor oil and cow dung or sheep dung. It is then removed, washed well in soft water and dried. Sometimes, the yarn is boiled in this decoction instead of
being merely steeped in it. In some places, the dung is omitted and the yarn is simply rubbed well with charred seeds of castor and then dyed. Sometimes, plantain ashes or the alkaline earth called khar, is also used instead of, or in addition to the sheep or cow dung. In exceptional cases like in Balasore (Orissa), the yarn is prepared for dyeing by steeping it in the juice of well-ripened pumpkins (boital or kudoo) or water melons (pani-kakharu) in the proportion of 2:1 of yarn to juice ratio [5].

At Lohardaga (Bihar), the yarn is rubbed well with a mixture of charred seeds of castor with water and cow dung, and kept in this paste for two days. It is then steeped and rubbed daily for 21 days in the ash water made from the ashes of the bija of sirgooja (the oil seed Guizotia oleifera), then boiled in this ash water and finally rinsed in cold water. For one kilogram of yarn, equal proportion of castor oil and 117 grams of cow dung are required [5].

In Cooch Bihar in West Bengal, the cotton yarn is steeped for three or four nights in a mixture of castor oil and country salt (ashes of plants), then dried and washed in soft water. In Jalpaiguri (West Bengal), cotton yarn is first mixed with oil and alkali, and kept in this state for a month. It is then washed well and dried [5].

In Cuttack in Orissa, yarn is steeped in a mixture of cold water, castor oil, a little cow dung, and any of the alkaline ashes. It is then rubbed vigorously at intervals and taken out. This same process is continued for four to five days, after which it is washed in cold water and dried [5].

2.2 Preparation of dye bath

The common practice to prepare the dye solution is cutting the roots, or sometimes only the bark of the roots, into small pieces, pounding them well, and steeping or boiling them in water. Generally, the dye bath along with the roots is used for dyeing purpose. Sometimes, the roots are also taken out from the dye bath and only the dye liquor is used for dyeing purpose [5]. In many cases, mordant is not used during the dyeing process. Preparation of dye bath varies from place to place.

In Singhbhum of Bihar, Ach root bark is placed in cold water with pounded castor seed and cow dung and allowed to infuse. The decoction is then boiled with the yarn to be dyed. A purplish red colour is obtained [5].

At Lohardaga in Bihar, a solution is made by boiling 1 part of lodh leaves, 2 parts of wood ashes with 8 parts of water and then filtered. The yarn, after being well rubbed with charred castor oil seed, is steeped in the above solution and dried. This process of steeping and drying is repeated four times. 2 parts of challi root bark is then boiled in 4 parts of water. The dried yarn is steeped in this solution, till deep red colour is obtained[5].

In another process a solution is made by boiling 2 parts of lodh leaves in 7 parts of water. One part powdered challi root bark is added to this. One part of bleached cotton yarn is rubbed with this solution and then left to steep for 24hrs. One part of fresh water is then added and the solution is boiled till the entire water evaporates. After 12hrs, the yarn is rinsed in cold water and dried in shade. A fresh solution of 1/2 part of challi root bark in lodh leaf is made, in which the yarn is again boiled and left to steep for 12hrs. It is then removed, washed in cold water, and dried in shade. A fine red colour is obtained [5].

In Dinajpur in West Bengal, 5 parts of ground daruharidra root in 6 parts of water is left overnight in a vessel. The roots are removed from the water in the next day and 2 parts of yarn is steeped for a day. Then 233gm of dry leaves of bhauri (Symplocos lucida) is mixed with the dye solution and boiled in an earthen pot and left to cool. The yarn is then removed and washed. The process is repeated three to four times, using fresh dye material each time to obtain a fresh red colour [5].

In Cooch Bihar of West Bengal, the fresh roots of daruharidra is bruised and steeped in water along with a small quantity of the powdered bark of the latkan tree (Bixa orellana). In this extract, the pre-treated yarn is steeped and boiled. It is then removed and washed. This process is repeated twice or thrice before the colour gets fixed. If powdered bhauli (Symplocos lucida) leaves are used instead of the bark of latkan, the resulting colour is a deeper red [5].

In Santal Parganas, the root of ach and bark of soodare pounded together and mixed with water. The pre-treated yarn to be dyed is immersed with constant stirring and left for 20 to 30 hours. It is then boiled and finally washed in cold water and dried. The result is a light shade of red and by repeating the process three or four times, a deeper colour is obtained [5]. In another process, the bark and roots of achara crushed to very fine powder and mixed with lime, ashes of burnt plants
and castor seeds. This mixture is left for four days and then boiled for a short time. The pre-treated yarn is steeped in this decoction and dried [5]. In Nadia (West Bengal), roots of achhu are cut into small pieces, crushed in a dhenki and steeped in water. A little amount of alum is mixed with it resulting in a fine red colour [5]. In Darjeeling (West Bengal), hardi bark is pounded and soaked in water. Ashes of plantain and the green leaves of bohari (Cordia myxa) is mixed with the solution and boiled. Yarn is repeatedly steeped in this dye extract, taken out and washed, till the desired shade is obtained [5].

In Balasore (Orissa), 1 kg of achhu, 100 gms of lodh bark, 200 gms of karapani, 200 gms of castor oil and water is boiled together. 900 gms of pre-prepared yarn is steeped in this solution. The colour is deepened by repeated soaking [5].

In these three areas of the former provinces of Bihar, Bengal and Orissa, four other varieties of Morinda are used for red colour, namely: Morinda bracteata, Morinda aug- ustifolia, Morinda persicaefolia and Morinda SP. Morinda bracteata called hundi by Paharias and huldikunj by Lepchas, is used as a red dye in the Terai area (Darjeeling district). Morinda augstifolia called ban hardi; is also used as a red dye by Nepalese and Lepchas. In the Garo hills (Assam), the cotton yarn is dyed red with this (Assam Aal, chenang). Morinda persicaefolia is used by Paharias and Lepchas in place of Aal. Morinda SP, known as rung-gach in Chittagong (now in Bangladesh) is used as a red dye. In dyeing with rung-gach, as in the case of other species of Morinda, the cotton yarn to be dyed is subjected to a preliminary process. Three methods are adopted for dyeing with rung-gach for red colour.

For cotton yarn weighing 5 seers, 5 seers of plantain ash, 5 seers of water and 5 chittaks of karan oil are required. The plantain ash is dissolved in water and filtered and karan oil is added to it. The yarn is soaked in this solution, rubbed vigorously and dried. The process is repeated for five days using the same solution. On the sixth day, it is washed well and dried. 5 seers of root of rung-gach mixed in 5 seers of water is pounded and washed in the same solution till all the colour comes out. Then 2 and a 1/2 chittacks of powdered dry bark of the kharula tree are taken and added to this extract. The previously prepared yarn is soaked in this dye solution and dried. Then for seven successive days the yarn is boiled in this dye solution for an hour and then allowed to dry. A dark red shade is obtained.

The cotton yarn is boiled in water to remove the grease and dirt. It is then washed in cold water and dried. It is then well soaked in a mixture of one part of mustard oil and three parts of ash solution made by imli ash or mustard plant ash in water and kept under cover for two days and then left in the sun for three days. It is again soaked in fresh ash solution twice daily and left in the sun for three days. The yarn is put out in the dew and then washed in cold water before dyeing. The root of rang-gachis powdered and added to the solution of the ash of the imli tree/ ash of the kalai bamboo or akorya bamboo. The wet yarn is soaked in this extract and kept under cover for three days to get a deep red colour.

1/2 seer of rung-gach roots is pounded into a pulp, and to it 1/3 seer of mustard oil and 1/2 seer of the ash obtained by burning either the young shoots of the mirtinga bamboo or of the kalai bamboo or the green wood of the imli tree are added. In the mixture one seer of cotton yarn is soaked and kept in it for three days, after which it is dried and washed with water to get rid of the oil. The result is a fine red colour [5]. Morinda augustifoliais called achhugachh or asukath by the Assamese, chenung or chengrong by the Phakials and Ntan by the Nagas. The Assamese dye red with asukath.

The Phakials steep the yarn in mustard oil or in oil obtained from a pig or elephant, and boil for an hour or two, and leave to dry in the sun. When thoroughly dry, it is washed and boiled with wood ashes in water and put out in the sun to bleach. Pounded achhugach and wood ashes are mixed in water and the yarn is placed in the mixture and warmed over fire. It is then allowed to stand for a day, after which, the yarn is taken out and left in the sun. The depth of the shade depends on the number of times the yarn undergoes the steeping process and subsequent exposure. This process is known in Sibsagar (in Assam) also, and it is said that great care has to be taken to see that the yarn, after being steeped in the oil is ready for dyeing. The test applied to ascertain this is to burn a small quantity of the yarn and if the ash is quite white, it implies that the thread is ready, if not; the whole process of steeping and boiling has to be repeated [5].

In Sibsagar, the bark is used as well as the roots. In Dibrugarh in Assam, manjit (Rubia) is used to make the colour a deeper red along with the roots of achhugachh. 4 parts of achhugachh root powder, one part of majethi (Rubia), 8 parts of mustard oil and 8
parts of water or ash water (kharpani) are used. It is said that iron or brass utensils should be used in the process. The yarn is placed in these ingredients and warmed for two or three hours over a slow fire and then left to dry in the sun. The process is repeated for three consecutive days.

In North Lakhimpur sub-division (in Assam), a deep red colour is obtained by mixing lime with pounded roots and bark of the achhugachh[5].

In Goalpara (Assam), leaves of the lateku (Baccauria sapida) are said to be used partly as a mordant and partly to make the colour a deeper red. For 2 seers of yarn, a seer of pounded chips of the bark and roots is boiled in 5 seers of water.

In Darung, only wood is used. One eighth of a seer of achhugachh wood is pounded and boiled in 2 seers of water; one seer of yarn is boiled in the mixture for two hours, and while boiling, 2 tolas (25 gms) of lateku (Baccauria sapida) bark are thrown in as a mordant. No mustard oil or plantain ash is used. The red colour so obtained is rendered more permanent by subsequently boiling the yarn with bharathi leaves [5].

In the Garo Hills of Assam, the roots of chenang used for dyeing red are probably the roots of a variety of Aal tree. The preliminary process of cleaning is similar to that used elsewhere in Aal dyeing. The yarn is rubbed well with pounded sesame seeds and the leaves of bambi or daggal (Sacrochlamys-pulcherrima) and left for two days and was then washed well. The dye solution is made by pounding the roots, steeping them in water and then boiling it three or four times in succession. When cool, the treated yarn is added. The solution is heated at 60°C. When the liquid cools, the thread is removed and washed. It is then again steeped in the dye liquor, heated, taken out and washed. These processes are repeated twice or thrice till the colour is sufficiently fast [5].

The plants called jeng, ganang, yador in Cachar, asukath in Assam, larnong in the Khasi hills and gisak in the Garo hills are probably a variety of all (Morinda citrifolia). Jeng is used with linseed oil (Linum usitatissimum) and kharapani in Cachar to produce a red colour[5].

In the Khasi hills, the seeds of the nei plant are pounded to powder and placed with the grey yarn in a vessel. The vessel is filled with hot water and then the yarn is taken out and dried in the sun. This process is repeated daily for a week. Then the bark of the lapongdong (Symplocos racemosa) tree and the bark of the root of the larnong (Morinda tinctoria) tree are pounded well and the powders well mixed, in equal quantities, in a vessel with water. The yarn is then put in and after letting it steep, taken out and dried in the sun till it became hard. It is then washed with hot water and the process is repeated [5].

The commonest form of Morinda used in NEFA (now Arunachal Pradesh) is undoubtedly Morinda augustinfolia; the other varieties are used chiefly by the hill tribes, especially the Khasis and Garos [5].

In Nagpur (Maharashtra), the yarn to be dyed is put in castor oil mixed water and kept for three to five days; it is then removed and dried in the sun. It is then placed in water in which doura wood ashes (plantain ashes gave a better shade) has been mixed and then taken out and dried in the sun. This is repeated twice or thrice daily for two or three days. The material is then put in the hot Aal dye solution (just short of boiling) and the dye is kept at the same heat. When the yarn is deep red it is removed, washed and dried in the sun. A fast red colour results [5].

In Chanda (Madhya Pradesh), and in Sambalpur (Orissa), the cotton yarn is dyed a brilliant red colour with Aal root. A quantity of Terminalia arjuna wood ash is diluted in water in a large earthen vessel. This is then strained through a cloth into another vessel and a small quantity of castor oil solution is added. The cotton hanks are then soaked in the mixture and left for two or three days, taking the hanks out twice a clay, drying them in the sun and again putting in the mixture. The yarn is then soaked in plain warm water and squeezed out of the yarn. Then Aal and Symplocos racemosa is rubbed into the thread with the hands. The yarn is then put back into the colouring matter solution and allowed to soak for three days, after which it is put on the fire and allowed to simmer till no liquid is left. The yarn is then allowed to cool for six hours and lastly washed in cold water and dried in the sun. The dyeing process is repeated twice as otherwise the colour, although fast, would not be a brilliant red [5].
In Buldana (Maharashtra), the cotton hank is first soaked in water containing the ash of the palash tree for twelve hours. After soaking, the liquid is removed, leaving the palash sediment, and a mixture of goat dung and til oil is mixed with it. The yarn is then steeped in the mixture during the night and taken out next morning and dried. This process is repeated for ten days, and then the yarn is ready for dyeing. The oiled and dunged yarn is then soaked in the Aal solution for twelve hours, and then boiled for about an hour until the yarn has taken on the desired colour. The yarn thus dyed is used by the weavers only for the borders of the cloths which are, as a rule, always white (grey) [5].

The "cold dyeing" process followed in Surat and Ahmedabad in Gujarat requires the yarn to be washed in plain water and dried, then steeped in a saponaceous mixture khuranni which is prepared by mixing castor oil, carbonate of soda (kharo), and water. The yarn is allowed to soak in this mixture for one night and dried without being washed. It is then exposed to the sun for seven hours and thereafter steeped in a small quantity of fresh water, beaten well, and kept tied in a moist state for the night. The next morning, it is again exposed to the sun. This process is repeated successively for eight days. The yarn acquires soft silk-like texture. A watery solution of powdered Aal root is prepared in an earthen vessel (kunda). A solution of alum prepared in boiling water is poured in the kunda and stirred. The yarn is steeped in the mixture and stirred well and left to soak for twenty-four hours and then stirred briskly again. This is repeated for four days after which the yarn is taken out, washed and dried. The dyed yarn is dipped in the alkaline solution of sodium carbonate (1 part) and water (8 parts) and dried [5].

3. Aal dye in present India
Kotpad from Koraput district in eastern Odisha is one place where the tribal women Panikas of Mirgan caste continue dyeing their yarns with Aal bark roots as they have been doing for centuries. The weavers (Mirgan Panikers) produce exquisite kotpad cotton sarees from this unique Aal dyed yarns.

Kotpad is a small tribal handloom cluster situated at 18.480 North (latitude) and 82.420 East (longitude), about 70 km away from Koraput in the state of Orissa, bordering Madhya Pradesh and Andhra Pradesh [6]. The plain weaves of Aal dyed yarns by the tribal weavers (Murgana caste) of this cluster have occupied a prominent place in the map of Indian Handloom Industry. The cluster is surrounded by the dense forest of Malkangiri and Umerkote area of the district. Due to favorable climatic condition Aal trees grow abundantly in these forests which are not found in any other forest of the country [5].

The Malkangiri jungles lying in the interiors of Eastern Ghats is home to a number of tribes like the Santhal, Kondh, Gond, Munda, Oraon and Bondo. The region has enjoyed greater immunity as it has been isolated from the rest of the country by a range of hills on the West, and the Bay of Bengal on the East. Consequently, the textiles of this region have retained a distinct native identity. The members of these tribes are totally self sufficient and cultivate their own land; spin, dye and weave fabrics for their own use.

The Panikars (weavers) of Mirgan caste have been weaving textiles for all the tribes living in these eastern hills of Odisha probably since 3rd Century BC [5]. They dye thick rough hand spun cotton yarns directly purchased from Jagdalpur (Chattisgarh), Rayagada and Sambalpur (Odisha) in varying shades of red using locally available Aal roots through an indigenous process. The men weave these naturally dyed yarns on rudimentary pit looms using three shuttle weaving technique. Motifs are mostly inspired from nature, have symbolic meanings and are specific to occasions. They are woven using extra weft. In spite of being rough spun, these sarees are simple and elegant.

3.1 Raw materials
Earlier women artisans would hand spin wild cotton and/or silk into yarn. This "katcha suta" or unprocessed cotton yarn is used to weave the cloth [5]. Today the cotton yarn is purchased from Sambalpur in the form of muda (rolls) packed in peti (box or cartoon). The number of muda in a peti depends on the count (Table-1). Tussar yarns are purchased from Jagdalpur, Rayagada and Sambalpur.

<table>
<thead>
<tr>
<th>Count</th>
<th>No. of Muda (Cotton Rolls) in a Peti</th>
</tr>
</thead>
<tbody>
<tr>
<td>10s</td>
<td>10</td>
</tr>
<tr>
<td>20s</td>
<td>20</td>
</tr>
<tr>
<td>60s</td>
<td>30</td>
</tr>
<tr>
<td>80s</td>
<td>40</td>
</tr>
<tr>
<td>100s</td>
<td>50</td>
</tr>
</tbody>
</table>
Aal root bark is collected for dyeing of yarns from the Aal tree roots, after rainy season and before the start of winter and stored for the use throughout the year. The experienced dyers of Kotpad mention that the younger trees do not give good dye. They use barks of the roots of trees more than 40 years of age. Flowers of this tree are small and whitish in colour like Jasmine flowers and have similar fragrance too. These trees are 30 to 40 feet tall and found in the mountains. Bark of the roots, 4 to 8 cm in diameter, is taken out to be used for dyeing. Barks of thinner roots give richer colour. The bark of the roots from mature trees can be taken again and again every year avoiding the monsoon period. These pieces of collected bark is broken into smaller pieces and stored. They dry these bark pieces further and pound them in a dhenki (pounding instrument used to take out the husk from rice) and store them.

Today Aal (Morinda citrifolia or Indian mulberry) trees are planted and cultivated for easy procurement of root bark for dye. Due to cultivation the plants bear flowers and fruits within 3 to 4 years. The roots are then ready to give bark for dye. The roots spread out on ground and are not too deep. Bark of the roots thicker than 1.3 cm are not used. With cultivation, roots of trees more than 4 years of age have become useless. Thicker and older roots do not produce root barks with dyeing substance. The root barks are collected by tribal and still sold to the women of Murgan tribe from Kotpad at tuesday weekly haat of Kotpad for up to Rs 2,000 to Rs. 3000 (depending on the quality) for a 10 kg sack. The entire pre-treatment and dyeing work is done by women of only 12 houses in Kotpad belonging to the family of weavers.

Today the procured root barks are broken into smaller pieces and are washed properly to remove impurities. The root bark pieces swell when they come in contact with water and therefore are dried by spreading on a chatai (reed mat) in the sun. These dried bark pieces are nowadays powdered in electrical grinders and stored in earthen pots for further use. High humidity of rainy season degenerates this powder, thus dyeing is done in winter and dry months that is between November and April.

Thus when the bark is taken from trees of the forest, trees of the age of 30 to 40 years are considered good, but when they are cultivated, age of 3 to 4 years is desirable [5].

3.2 Steps before dyeing
The method of dyeing and weaving of Kotpad textiles has its own significance and uniqueness.

Yarn varying from 10 to 20 counts (generally 14 counts) is taken in 4 knots (approximately 650 gms) at a time. They are linked together so that they can easily be spread and dried on wooden planks or chatais (reed mats). A maximum amount of 50 Kgs is taken at a time.

Colour from Aal has no direct affinity for the cotton yarn and hence the yarn is treated with castor oil, cow dung and alkaline water before dyeing.

3.2.1 Treatment with castor oil
Castor oil is obtained from the seeds of Ricinus communis (Linn). 4 knots of yarn (4 knots of 20s yarn weighs 650 g) is immersed completely in water and after squeezing of excess water it is spread on a chatai or a wooden plank. 500 g of good quality castor oil mixed in 5 lts of maand (rice water) is sprinkled on the yarn. The yarn is rubbed with the palm for about 15 min and further kneaded with the feet for another 15 min (Fig. 2).
3.2.2 Treatment with cow dung

2 to 3 Kg of cow dung is required for the 4 knots of yarn. Fresh dung is collected in earthenware and a small quantity of water is added and mixed to create a thick paste. This paste is slowly smeared and rubbed on the wooden plank or chatai on the castor oil treated yarn. Gradually the entire yarn is well coated with cow dung (Figure 3). The yarn is then placed on the chatai/wooden plank or hung and dried in presence of sunlight.

The process involving castor oil and cow dung is done only once even though other steps for dyeing are repeated for darker/richer colour.

3.2.3 Treatment with kharapani (alkaline solution)

2 kg of ash from burnt wood or Niger seed husk (Ram til / kala til) or gingili/season stalk (safed til) is added to 25 lts of water in an earthen pot. The solution is well stirred and then allowed to settle. The clear water from the top is poured in another earthen pot and heated to a temperature of around 50°C to 60°C. The oil and dunged yarn is spread evenly on wooden plank/chatai. The kharapani is sprinkled by hand on the dried yarn till it is totally drenched. They are kneaded by hand and foot for 15 min and spread to dry. The sprinkling of kharapani is repeated 3 to 4 times every day and is done for about 8 consecutive days. Thus the kharapani treatment is repeated 25 to 30 times till the yarns start foaming with the application of kharapani. The yarn is then dipped in clean water, washed thoroughly and dried. After washing, the yarn looks yellowish brown and is ready to absorb the Aal dye (Figure 4).

3.2.4 Dyeing process

About 1 kg of Aal powder is mixed with 10 liter of water and stirred well to get a good suspension in an earthen pot. 4 knots (650 g yarn) pre-treated cotton yarn is immersed in the pot. The soaked yarn is then taken out and spread on a wooden plank. Another 500 g of Aal powder is sprinkled over it and the yarn is further rubbed and kneaded for 10 to 15 min. The yarn is then kept into the earthen pot with Aal suspension and the pot is kept in the sun for a day. The pot is then put on fire and the suspension boiled till the water evaporates. The yarn is stirred intermittently using a wooden stick. The yarn is then washed and dried in the sun. Dyed yarn is called Achi.

Pre treatment with kharapani and dyeing with Aal powder may be repeated several times to achieve richer and deeper shades of red (Fig. 5). Once the desired shade is achieved, the yarn is thoroughly washed in

Figure 2

Figure 3

Figure 4
clean flowing water and dried. This dried yarn is ready for weaving.

Ferrous sulphate (kumahar pathar) is used to dye the yarn in shades of blackish bluish red. The slag obtained from the local cottage iron smelting industry is mixed with jaggery and water and fermented in mud pot till the solution becomes black. Thereafter, this solution is mixed with Aal powder suspension and dyeing process is continued as before. For a deeper bluish black-red colour 500-250 g of copper sulphate is also used in the third bath.

It takes a minimum of 3 weeks to complete one dyeing cycle. This unique dyeing process makes the cloth soft and does not leave any shine or smell. The colour is radiant and fast.

Kotpad weavers work with only yarns dyed with Aal root bark in shades of red, ranging from dull brick red (jyotil ancha), bright brick red (Kariya ancha), deep maroon red (Jyotil gahir), blackish maroon (Kariya gahir) to chocolate brown (kala) along with “kora” shade of cotton (unbleached white). This combination makes their textiles unique.

4. Conclusions
Today only 12 panikas(women dyers) are continuing with Aal dyeing. All of them belong to Kotpad and thus dyeing is limited only to Kotpad. They do not prefer using fine yarn as they feel the yarn will lose its strength due to vigorous pre treatment and dyeing process. The cotton yarn used to make the saree is expensive and there is poor availability of Aal roots. Further, the extraction of the root bark and dyeing of the yarn involves a complicated and time consuming process. This has forced the tribal to use cheaper, more colourful and easy to maintain mill-made sarees. The limited variations in colour and yarn quality have made the demand for Kotpad textiles static. The present generation has no interest in such labour intensive, repetitive and less lucrative work. With the ready availability of cheap synthetic dyes and relative ease of application a gradual decline in the use of Aal dyes is noticed.

References
1. Introduction
Textile processing industry consumes huge amounts of water, chemicals and energy. The generated effluent in turn contains hazardous, toxic and non-biodegradable substances causing many carcinogenic diseases [1][2]. Interest towards revival of natural colourants in textiles is proliferating with rapid rise in awareness about environmental conservation [3][4]. The natural colourants and finishes have many advantages over synthetic ones like they are non toxic, biodegradable, non carcinogenic and helps in reducing the carbon footprints [5][6]. Thus, there is an increasing interest to find renewable resources for the production of natural dyes. Therefore unwanted wastes from agriculture and forest appear as a good choice of raw material for extraction of colours [7-11]. Arjuna is one such tree belonging to Combretaceae family which is a host plant of tasar silk moth [12]. It is also used in ayurveda owing to many medicinal properties [13]. Its bark is soft and reddish in colour and contains large amount of bio active contents[14] like flavanoids and tannins [15]. It is reported that aqueous extract of Terminalia arjunais reported to have 16% tannins [16] and 44% polyphenols[17]. Tannins are considered to have wound healing, astringent, hypotensive, antioxidant and antimicrobial effects [18].

Natural fibres are susceptible to microbial attack as these absorb moisture and provide suitable environment required for microbial growth[19]. Hence development of clothing that could provide a desired antimicrobial effect becomes necessary in certain applications. Many natural dyes and finishes exhibit antimicrobial, antioxidant and anti-carcinogenic activities because of the components present in them [20-23], which make them ideal to be used in textiles[24][25]. Many plants having medicinal properties possess remarkable antimicrobial activity too because of presence of large amount of tannins[26]. It was reported earlier that natural biopolymers [27][28][29] as well as tannin based natural ingredients can be used as mordanting agents satisfactorily with some of the natural dyes [30] which means if a plant is rich in tannin, it will give good fastness property itself. Chemical constituents present in aqueous extract of bark powder of Terminalia arjuna makes it highly potential to act as natural dye having additional functional properties for textile substrate. Keeping in view them edical effects of Terminalia arjuna, the objective of the current study is to optimize the application of colourant extracted from Terminalia arjuna Bark on khadi cotton fabric using response surface design. Further UV protection and antibacterial activity of dyed fabric were evaluated.

Functionalization of Antibacterial and UV Protection Properties in Cotton Fabric Dyed with Terminalia Arjuna Bark Extract

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Abstract
Khadi cotton fabric was dyed with Terminalia arjuna bark extract in an attempt to get additional properties like antibacterial and UV protection along with dyeing. Dyeing conditions play an important role in colour value of fabric so in this study, dyeing conditions like time, temperature and pH were optimised using response surface design taking colour strength as a response. Terminalia arjuna bark extract produces reddish brown colour to dyed cotton fabric with satisfactory fastness properties. Dyed fabric also exhibit good antibacterial activity against S. aureus and E. coli along with excellent UV protection properties. Thus, Terminalia arjuna bark extract avoid need of applying separate chemical finishing agent as it functionalizes cotton fabric sustainably in single dyeing step.

Keywords
Antibacterial activity, Natural dyeing, Response surface design, Terminalia arjuna, UV protection property

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National Institute of Technology, Jalandhar, Punjab, India
2. Materials and methods

2.1 Materials
Ready to dye khadi cotton fabric of 22 epi and 26 ppi having 143 gsm was purchased from local market. Mild soaping was carried out before dyeing the fabric. Terminalia arjuna bark powder was purchased from local market and used as it is for extraction of colour. All other chemicals used in the study were of laboratory grade.

2.2 Methods

2.2.1 Extraction of colour
Extraction of colour from bark of Terminalia arjuna was carried out using soxhlet apparatus. Extraction can be carried out by choosing any suitable solvents\[31\]\[32\]. Water based extraction was carried out being good solubility of colouring constituents of Terminalia arjuna in aqueous solution. Known amount of Terminalia arjuna bark powder was kept in soxhlet apparatus keeping MLR 1:30 at pH 8 for 30 min \[33\]. Extract thus obtained was filtered and used as it is for dyeing.

2.2.2 Dyeing
Box and behnken response surface design was used for optimizing the dyeing conditions by taking time, temperature and pH of dye bath as variable factors. These factors were evenly spaced and coded as low, medium and high as indicated in Table 1. In all the dyeing cycles MLR was kept 1:30. No other chemicals were added to dye bath to keep the process eco-friendly. To optimize the variables of dyeing condition colour strength (K/S) value of the dyed fabric was considered as the response. Higher the value of colour strength means more dye is transferred to the fabric from dye bath. As per the design of experiments, fifteen experiments were carried out and are shown in Table 2. Design of experiments (DoE) software version 12 was used for the analysis of data. To analyze the relation of response with variables the module applied a quadratic polynomial equation. Statistical significance of the model equation and R² value were also determined.

![Flow chart of experimental design](image1)

After dyeing the samples were washed with 2 gpl non-ionic soap solution at 60°C for 10 minutes and then rinsed thoroughly with cold water and dried. Once the dyeing conditions are optimized, evaluation of dyed samples was carried out only for the samples dyed at optimized conditions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>A: Temp (°C)</td>
<td>50</td>
</tr>
<tr>
<td>B: pH of dye bath</td>
<td>4</td>
</tr>
<tr>
<td>C: Time (min)</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 1: Variables used in Box and Behnken design
Table 2: Box and Behnken surface response design for optimization of dyeing conditions

<table>
<thead>
<tr>
<th>Run</th>
<th>Variable 1 (Temp °C)</th>
<th>Variable 2 (pH of dye bath)</th>
<th>Variable 3 (Time (min))</th>
<th>Response K/S</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>50</td>
<td>4</td>
<td>90</td>
<td>1.434</td>
</tr>
<tr>
<td>2.</td>
<td>50</td>
<td>6</td>
<td>60</td>
<td>0.913</td>
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<tr>
<td>3.</td>
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<td>6</td>
<td>120</td>
<td>0.804</td>
</tr>
<tr>
<td>4.</td>
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<td>8</td>
<td>90</td>
<td>0.433</td>
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<tr>
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<td>1.755</td>
</tr>
<tr>
<td>6.</td>
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<td>4</td>
<td>120</td>
<td>1.96</td>
</tr>
<tr>
<td>7.</td>
<td>70</td>
<td>6</td>
<td>90</td>
<td>1.19</td>
</tr>
<tr>
<td>8.</td>
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<td>6</td>
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<td>1.14</td>
</tr>
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<td>1.15</td>
</tr>
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<td>8</td>
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</tr>
<tr>
<td>11.</td>
<td>70</td>
<td>8</td>
<td>120</td>
<td>1.029</td>
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<tr>
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<tr>
<td>14.</td>
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<td>6</td>
<td>120</td>
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</tr>
<tr>
<td>15.</td>
<td>90</td>
<td>8</td>
<td>90</td>
<td>1.419</td>
</tr>
</tbody>
</table>

2.2.3 Evaluation of dyed samples

**Colour value**

Colour strength expressed as K/S was measured by the light reflectance technique [34]. The relative colour strength was calculated by applying the Kubelka-Munk equation as given below:

\[
\text{Colour strength (K/S)} = \frac{(1 - R)^2}{2R}
\]

Where, \( R \) is the reflectance of fabric samples at \( \lambda_{\text{max}} \); \( K \) is the absorption coefficient and; \( S \) is the scattering coefficient.

The colour values (\( L^*, a^*, b^* \)) of different sample were determined using premier colour scan spectrophotometer and software interfaced.

**Colour fastness property**

Fastness to washing and rubbing (wet and dry) of dyed samples was determined as per IS: 3361-1979 test method in a Launder-O-Meter and ISO-105-X12 test method using a crockmeter respectively. Fastness ratings for washing and rubbing of the samples were evaluated by the computer colour matching system. On exposure to light for prolonged period the colour of the samples were getting darker instead of fading so rating could not be done as per the standards and only the change in the depth of shade is mentioned.

2.2.4 Antibacterial Property

AATCC-100 test method was used to do quantitative assessment of antibacterial behavior of dyed fabrics using gram positive (S. aureus) and gram negative (E. coli) bacteria. The reduction in number of colonies formed in test sample with respect to the control sample gives us the percentage of antibacterial activity. Following equation was used to calculate the reduction in bacterial count:

\[
\text{Reduction in bacterial count (R)%} = \frac{(B - A)}{B} \times 100
\]

Where, \( A \) = the number of bacterial colonies recovered from the inoculated treated test specimen incubated for 24 hrs
\( B \) = the number of bacterial colonies recovered from the inoculated untreated test specimen incubated for 24 hrs

2.2.5 UV Protection Property

UV Transmittance Analyser- UV2600 was used to check UV protection factor using AS/NZS 4399-1996 standard test method. The ratio of ultraviolet radiation irradiance of unprotected skin (i.e. skin covered by undyed fabric) to ultraviolet radiation irradiance of protected skin (i.e. skin covered by dyed fabric) gives ultra violet protection factor (UPF).

\[
\text{UPF} = \frac{\text{risk unprotected}}{\text{risk protected}}
\]

Where,

- risk unprotected = \( \Sigma S \lambda A \lambda \Delta \lambda \)
- risk protected = \( \Sigma S \lambda A \lambda \Delta \lambda T \lambda \)
- \( S \lambda = \text{source spectrum (Wm}^{-2} \text{nm}^{-1}) \)
- \( T \lambda = \text{transmittance} \)
- \( A \lambda = \text{action spectrum for measured response} \)
- \( \Delta \lambda = \text{bandwidth in nm} \)

The minimum wavelength range was 290nm -400nm.

3. Results and discussion

Dyeing experiments were performed by varying the dyeing conditions as shown in Table 2 and the results thus obtained are discussed below. The plot of the predicted against actual values of colour strength is shown in Figure 2 and gives an adequate judgment of the model. Here the actual values of colour strength are harmonizing with the predicted values which mean the second order regression model attained is satisfied. The \( R^2 \) achieved for the fitted model is 0.9681 with P-values of variables A, B, C as 0.0424, 0.0001, < 0.0001 respectively, all values are less than 0.0500 which indicates model terms are significant. P-values less than
0.0500 indicate model terms are significant. In this case A, B, C are significant model terms with $R^2$ 0.9681.

3.1 Effect of dyeing conditions on K/S value
Responses attained with respect to the independent variables are shown in the surface plot given in Figure 3. It is clear from the figure that time has least role to play while temperature and pH values are important factors governing the dyeing process. Time doesn’t play much role after reaching a certain time limit as equilibrium reached between absorption and desorption of colourant on textile material with prolonged dyeing period[35]. In 60 min all the colouring molecules available in dye bath got transferred to fabric and after 60 min up to 120 min not much increase in colour strength values were observed. Increase in temperature increases the dyeing rate by giving more energy to the system for better mobility. Hence increase in colour strength value was observed when the temperature was raised from 50°C to 90°C. Change in pH has a huge effect on the colour strength values of samples. As the pH goes towards acidic side the K/S value increases and it was found maximum at 4 pH. Dyeing behavior depends largely upon the ionic interaction between colour molecules and substrate which are highly influenced by pH. Design of experiments gave 56 solutions to have desired high value of colour strength but the most feasible and easy to maintain conditions to get the optimized colour value on cotton fabric were when dyeing was carried out at temperature of 90°C for 60 min maintaining pH 4 of Terminalia arjuna bark extract.

The following response equation has been obtained to predict the colour strength value (K/S). It shows the effect of Time (A), Temperature (B) and pH of dye bath (C) on the response and can be used to make predictions about the response for given value of each variable.

$$K/S = +3.07409 + 0.036681 \times Temp - 1.03969 \times pH + 0.000163 \times Time + 0.003206 \times Temp \times pH - 0.000090 \times Temp \times Time - 0.000813 \times pH \times Time - 0.000230 \times Temp^2 + 0.057594 \times pH^2 + 0.000056 \times Time^2$$

When the optimised dyeing conditions i.e. temperature - 90°C, time - 60 min and pH - 4 were put in the above equation the calculated colour strength value comes out to be 1.95937, while the actual experimental value was found to be 1.962. It is clear that this equation predicts the colour strength value correctly up to one decimal point and can be relied upon.

3.2 Colour Value and Fastness rating
Table 3 (a) and (b) shows the colour value and fastness rating of dyed sample. The shade obtained with Terminalia arjuna bark on cotton is reddish brown. Both $a$ and $b$ value obtained are positive and are 9.592 and 13.454 respectively. Obtained L value is 57.56 which give the fabric moderate darkness. The fastness to washing has good rating but the wet rubbing fastness of the sample is poor. On exposure to light, the colour of dyed sample becomes darker instead of fading. Here oxidation of natural colourants may be the reason of fabric getting darker on exposure to sunlight with passing of time.
Table 3 (a) : Colour Values of sample with optimised conditions of dyeing

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Dyeing Conditions</th>
<th>Colour Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temp</td>
<td>pH</td>
</tr>
<tr>
<td>Un dyed cotton sample</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dyed cotton sample</td>
<td>90</td>
<td>4</td>
</tr>
</tbody>
</table>

*Predicted value from equation; $Actual experimental value

Table 3(b): Colour Fastness rating of dyed sample

<table>
<thead>
<tr>
<th></th>
<th>Wash Fastness</th>
<th>Rubbing Fastness</th>
<th>Light fastness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fading</td>
<td></td>
<td>Staining</td>
<td>Dry</td>
</tr>
<tr>
<td>Cotton</td>
<td>3-4</td>
<td>4-5</td>
<td>4</td>
</tr>
<tr>
<td>Wool</td>
<td>3-4</td>
<td>2</td>
<td>Darker</td>
</tr>
</tbody>
</table>

3.3 Antibacterial Property

Antibacterial efficiency of Terminalia arjunabark extract was calculated in terms of percentage reduction of bacterial colony against both gram positive and negative bacteria. Chemical structure and the functional groups present play important role in imparting antibacterial activity in natural extract. Terminalia arjuna shows antibacterial properties[36], as it contains a luteolin compound which is reported to have antibacterial activity [11]. Sample dyed with Terminalia arjuna bark extract supports the literature and showed good antibacterial activity as shown in Table 4. Finding of the study shows that obtained bacterial reduction by dyed cotton fabric with Terminalia arjuna bark extract for S. aureus and E. coli was 98.80% and 95.26%, respectively.

Table 4: Photographs of bacterial colonies in undyed and dyed fabrics

<table>
<thead>
<tr>
<th>Cotton Fabric</th>
<th>Undyed</th>
<th>Dyed with Terminalia arjuna bark extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. aureus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. coli</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.4 UV Protection Property

It is more convenient if the clothing can provide sufficient UV protection property themselves to wearer as it avoids need of applying sunscreen lotions separately to skin covered under the apparels. Some natural pigments have inherent ability to reduce or prevent transmission of harmful UV radiation [37]. These natural dyes can be explored for dyeing as well as for imparting UV protection property on to the fabric. Terminalia arjuna is one such dye which has various phenolic contents which show free radical scavenging action [38] and has ability to protect from UV rays. UPF rating of the samples are given in Table 5. It is clear from Figure 4 that undyed fabric allows the transmission of UV rays while dyed fabric blocks UV radiations significantly and % transmission is near to zero.

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Undyed cotton has no protection from UV radiations while cotton fabric dyed with Terminalia arjuna bark extract provides excellent protection from UV radiations with a UPF rating of 50+.

### 4. Conclusion
The focus of study was to optimize the dyeing conditions using response surface design to khadi cotton with Terminalia arjuna bark extract. Finding of dyeing studies shows that temperature and pH has significant effect on the K/S values of dyed samples. Dyed fabric with Terminalia arjuna bark extract shows good wash fastness along with darkening of shade of the sample on exposure to light. Terminalia arjuna bark extract imparts excellent antibacterial properties in khadi cotton with bacterial reduction of about 98.80% and 95.26% for S. aureus and E. coli, respectively. Besides imparting colour and antibacterial properties, Terminalia arjuna bark extract also provides excellent UV protection properties with more than 50 UPF rating to treated cotton fabric. Thus Terminalia arjuna bark extract can be used as single dyeing and finishing agent with beneficial antibacterial and UV protection properties.

### 5. Acknowledgements
Thanks are due Department of Fibre and textile processing technology, ICT Mumbai for helping with the UPF testing and to Department of Textile Technology, IIT Delhi for helping in carrying out antibacterial testing. Authors are grateful to UGC, Government of India for providing financial support for this research work.

### References
Preparation of Silk Fibroin / PVA Hydrogels Using Chemicalfree Cross-Linking for Tissue Engineering Applications

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Department of Fibres and Textile Processing Technology, Institute of Chemical Technology

Abstract
Tissue scaffolds mandate the application of inter-disciplinary approach for successful preparation. The contribution of textiles to this multi-disciplinary field is through many facets. This paper discusses the preparation of 3D porous hydrogels using fibroin extracted from silk fibres. To increase the flexibility and to have differential degradability, fibroin is blended with different concentrations of PVA (2, 5, 10%) to explore its tissue engineering potential. The 3D sponges were prepared using freeze drying technique without using any external cross-linking agents. All the prepared sponges were evaluated using SEM, FTIR, XRD, TGA, swelling ability and mechanical properties. The results demonstrated that the prepared hydrogels have the desired characteristics for the possible application in engineering tissue in the human body. The degradation studies of these prepared sponges showed that the variation in concentration of PVA effected in the variation in the degradation time, thus providing a parameter for selection of the sponges as per the requirement of retention in the tissue regeneration.

Keywords
Tissue scaffolds, 3D sponges, freeze drying freeze - thawing gradation

1. Introduction
The ideal scaffold or tissue support for its use in engineering of tissues should have sufficient elasticity, flexibility, mechanical strength, and physical stability to maintain their shape. Besides these characteristics, biocompatibility, bio-resorbability, and porosity are also required for scaffolds. Hydrogels are hydrophilic 3D sponges having polymeric network with high swelling ratios in water. Due to their high moisture content and elasticity, they display ability to mimic human tissue than other synthetic biomaterials. Hydrogels have been extensively used in a vast range of biomedical applications, mainly in drug delivery and tissue engineering. Silk fibroin (SF) is studied by the material scientists for more than two decades for its application as biomaterial. It has very good biocompatibility and low inflammatory response. In order to make it easily biodegradable, regenerated form of SF is utilized. Various forms of this regenerated silk fibroin such as fibers, films, hydrogels, and 3D scaffolds are utilized as biomaterials in tissue engineering field. Hydrogels among these forms are gaining importance due to their peculiarly large surface area for activities of cell (cell growth, proliferation, adhesion, and migration). These prepared silk hydrogels have been sought for application in cell culture as a matrix, in drug and gene delivery systems and also as artificial skin. However, brittleness and lack of flexibility in the structure makes it difficult for the practical use of the silk hydrogels[1].

This limitation of silk hydrogel can be overcome by blending with various other biomaterials which have high elasticity such as polyethylene glycol, poly-lactic acid or poly-vinyl alcohol (PVA). PVA structures have higher mechanical properties in terms of elasticity and strength thus can complement silk fibroin in formation of hydrogels. PVA as a biomaterial has been explored for applications such as artificial joints, artificial blood vessels and drug-releasing systems[2]. The blended hydrogels are cross linked to improve the durability during the application in the biological system. This cross linking can be effected by either use of chemicals, physical methods or by using irradiation. Irradiation techniques are not cost effective. The use of different chemical cross linkers give efficient cross linking in hydrogels however, is detrimental for the cell activities and have toxic residues which affect the bioactivity [3]. Many chemical cross-linkers are used for
improving the cross linking of molecules in the hydrogels. PVA-based hydrogels are developed via different cross-linking processes such as physical, chemical, and irradiation cross-linking. Physically cross-linked hydrogels (freeze-thawing hydrogels without toxic residues) offer improved mechanical properties compared to hydrogels made by chemical (have toxic residues) and irradiative (expensive) cross linking techniques. Owing to its biocompatibility, ease of processing, and suitable mechanical strength, freeze-thawing PVA hydrogels have been extensively used in many tissue engineering applications[4]. The difference in freeze thawing and freeze drying process is that freeze thawing is yet to appear on industrial scale whereas the freeze drying is already an industrially established process[5].

The presented work describes the application of SF extracted from silk fibre in the form of hydrogel. SF is blended with PVA and processed using freeze drying technique to form hydrogels. The prepared hydrogels were evaluated for its suitability and application in the field of tissue engineering and regenerative medicine.

2. Materials
2.1 Preparation of SF solution
The silk fibres were treated in 0.5% Na₂CO₃ solution owf at 95°C with three repetitive cycles (30 min each) to remove sericin. Then the fibers (silk fibroin) were rinsed and dried at room temperature. The resulting pure fibroin fibers were dissolved in 9.3 M LiBr solution at 65°C for 4 hours. The solution was filtered and then dialyzed against water for three days. Concentration of solution obtained was adjusted to 5 %.

2.2 Dissolution of PVA
Polyvinyl alcohol LR (MW. 125,000) was purchased from S D Fine Chemicals Ltd., Mumbai. It was dissolved in deionized water by heating in a water bath at 95°C for 2 hours. Three different concentrations of the aqueous PVA solution were prepared; 10 %, 5 % and 2 % (w/w).

2.3 Preparation of porous PVA/SF blend hydrogels
SF solution (5 %) and PVA (2, 5 and 10 %) were blended at blending ratios as SF: PVA :: 100:0, 80:20, 60:60, 40:60, 20:80. The blends were mixed and immediately poured into glass petri plates. These petri plates were then sealed with an aluminum foil and frozen at -20°C for 24 hours, followed by lyophilization (Labconco, Missouri, USA) at -60°C and 0.01 mbar, for 18 hours. The lyophilized porous hydrogels were then stored in desiccator until further use.

The hydrogels were named as below;

<table>
<thead>
<tr>
<th>% SF</th>
<th>% PVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 %</td>
<td>5 %</td>
</tr>
<tr>
<td>10 %</td>
<td>10 %</td>
</tr>
<tr>
<td>20 %</td>
<td>20 %</td>
</tr>
</tbody>
</table>

Table 1: Ratio of SF (5 %): PVA in prepared hydrogels

2.4 Fourier-transform infrared spectroscopy
Fourier-transform infrared spectroscopy (SHIMADZU FTIR-8400S) was used to understand the interaction of SF and PVA during the blending and freeze drying of the hydrogels. The absorbance of the samples was recorded between 4000 - 500 cm⁻¹ region, 32 scans in each case at a resolution of 4 cm⁻¹. Background measurements were taken twice with an empty cell and subtracted from the sample readings.

2.5 X-Ray Diffraction (XRD)
Shimadzu 6100 model of X-ray diffractometer equipped with Cu Kα radiation (λ = 1.54 Å) was used to evaluate the XRD analysis of the samples. The 2θ angle ranged from 5 to 35°. The generator voltage was kept at 40 kV and generator current was 30 mA, in step of 0.02°. Variation of crystallinity due to variation of the ratio of the SF and PVA in the hydrogels was observed from the diffraction graphs of the blended hydrogels.

2.6 Thermo gravimetric analysis
Thermo gravimetric analysis (TGA) was used to evaluate thermal decomposition behavior of all samples. Thermo gravimetric measurements were made using TG/DTA Simultaneous Measuring Instrument (DTG-60H SHIMADZU). The study was conducted over a temperature range of 30-500°C at a heating rate of 10°C/min under a nitrogen atmosphere. The mass of the sample pan was continuously recorded as a function of temperature. TGA analysis gave a detailed relation of variation of the ratio of SF and PVA.

2.7 Swelling properties
The hydrogels were tested for their swelling behavior using DI water. Their weight in a dry state was measured using an electronic balance. Their weight in a swollen state was measured after incubation for 2 h, 4 h, 6 h, 9 h, 12 h, and 24 h in distilled water. This test was repeated three times under the same conditions. Specific water content (%) was calculated as an index for swelling of the gel according to the following equation.

The hydrogels were named as below;

Table 1: Ratio of SF (5 %): PVA in prepared hydrogels

<table>
<thead>
<tr>
<th>% SF</th>
<th>% PVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 %</td>
<td>5 %</td>
</tr>
<tr>
<td>10 %</td>
<td>10 %</td>
</tr>
<tr>
<td>20 %</td>
<td>20 %</td>
</tr>
</tbody>
</table>
Specific water content: \[ \frac{\text{Ww} - \text{Wd}}{\text{Wd}} \times 100 \]

\( \text{Wd} \): Dry weight of the hydrogel.
\( \text{Ww} \): Wet weight of hydrogel after swelling.

2.8 Mechanical properties
Tensile strength of samples was determined according to the ASTM D 5035(1995) standard (test method for breaking strength and elongation of Textile Fabrics) using Tinius Olsen H5KS universal tensile machine (UTM). Breaking force is the maximum force applied to a material to rupture and the corresponding elongation is the ratio of the extension of a material length to the length prior to stretching, expressed as a percentage. The test was performed with a 5 kN load cell at room temperature with crosshead speed 10 mm/min. Three specimens were tested for each of the SF/PVA blends.

2.9 In-vitro degradation
The degradation of the hydrogels was evaluated at three different environmental conditions; Hydrogels were immersed in three different solutions to study in-vitro degradation - PBS, SBF and protease XIV (as supplied by the M/s. Rossari Biotech Ltd.). The enzyme of 2 mg/mL concentration was prepared in PBS control. The standard SBF solution was prepared according to Kokubo’s protocol [6] by dissolving specified amount of the relevant reagent grade chemicals in distilled water. The inorganic ions concentrations in this standard SBF (\( \text{Na}^+ \) 142.0, \( \text{K}^+ \) 5.0,\( \text{Mg}^2+ \) 1.5, \( \text{Ca}^2+ \) 2.5, \( \text{Cl}^- \) 147.8,\( \text{HCO}_3^- \) 1- 4.2,\( \text{HPO}_4 \) 2 - 1.0, and \( \text{SO}_4 \) 2 - 0.5mM) were closely equal to those in human blood plasma.

A sample size of 25mm\(^2\) was utilized for the study. The environment temperature of 37°C similar to the human biology was maintained in the autoclave throughout the in-vitro degradation process. After the specific time, the samples were removed from the solutions and weighed for recording the degradation. The enzyme and SBF solutions were replaced with newly prepared solution every 24 h and 72 hours.

3. Results and discussion
3.1 Fourier-transform infrared spectroscopy

Figure 1: FTIR absorbance spectra of SF/PVA freeze dried hydrogels

In the hydrogels having the concentration of PVA 2 % (figure 1.a), the peaks of SF depict the increasing
intensity of random coils represented at 1655 cm\(^{-1}\) as the ratio of the SF/PVA hydrogels decrease. The \(\beta\) sheet peak at 1520 and 1625 cm\(^{-1}\) show decreasing intensity as the ratio decrease. A shift towards random coil region is observed in the amide II region as the concentration of PVA increase. The peaks of PVA in the FTIR increase gradually at the intensity around 1432 cm\(^{-1}\) (CH-OH Bending) and 1246 cm\(^{-1}\) (C=O stretching). In the SF/PVA blends having 5 \% PVA the SF peaks show decreased intensity for both the random coil and \(\beta\) sheet region. As the concentration of PVA increases in the blend, the peaks at 1540, 1655 cm\(^{-1}\) (Random Coil), 1530, 1625 cm\(^{-1}\) (\(\beta\) sheet) show lower intensity peaks. (Ref) The hydroxyl region show significant increase in the spectra as concentration of PVA increase in the blend. CH-OH peaks (1432 cm\(^{-1}\)) are less intense while the CO stretching show increasing intensity and broad peak at 1246 cm\(^{-1}\) as the concentration of PVA increase. The SF/PVA hydrogels having 10 \% concentration of PVA show significant peaks representing PVA. The intensity of the SF peaks show decreasing trend in the amide I region while the peaks in the amide I region disappear as the ratio of SF/PVA blend decrease. The hydroxyl region show significant increase as PVA concentration increase. Overall the FTIR spectra display the concurrence of silk I crystalline structure and random coil conformation. The curves are characterized by the presence of absorption bands typical of both components. It can also be stated that the width of the region representing the hydroxyl groups (3500-3200 cm\(^{-1}\)) is stretched by blending PVA and SF, thus increasing the intensity of hydrogen bonding. FTIR spectral results implied SF molecules had interactions with PVA\[7\].

3.2 X-Ray Diffraction (XRD)

Figure 2.a (5 \% SF & 2 \% PVA)

Figure 2.b (5 \% SF & 5 \% PVA)

Figure 2.c (5 \% SF & 10 \% PVA)

Figure 2: X-Ray diffraction spectra of SF/PVA freeze dried hydrogels.

The prominent peaks for both PVA & SF are in the region of 2theta 20\(^{\circ}\). Thus super imposition of the intensity of the crystalline PVA along with SF around 20\(^{\circ}\) gives highest intensity of peak for the blend, 60/40/2 because of the contribution. Peaks with lesser intensity are observed around 12\(^{\circ}\) representing PVA. The intensity of amorphous Silk I peaks around 20-25\(^{\circ}\) is reduced as the concentration of PVA increase in the hydrogel. For sample having 5\% PVA, amorphous peak of the SF is seen to be dominant as the peak of the X-ray diffraction shifts towards 19\(^{\circ}\). Overall crystallinity is contributed by PVA since the blend containing highest concentration of PVA show highest intensity[8,9].
3.3 Thermo gravimetric analysis

Figure 3: Differential thermal analysis of SF/PVA hydrogels prepared by freeze drying.

The DTG curves obtained for freeze dried SF/PVA hydrogels are related to two mass losses. The first one occurring from the dehydration and removal of residual water from the samples and later on as the temperature increase, the mass loss occurs due to the break-down of side chain groups of amino acid residues, as well as the cleavage of peptide bonds[10]. As seen in figure 3, major mass losses during the study states that the two components of the hydrogel degrade at the respective degradation peaks. Hydrogels having higher content of silk fibroin show degradation peaks around 290°C due to the melting and decomposition of SF chains[11]. The PVA degrades at higher temperature and hence as the PVA content of the hydrogel increases the degradation peaks shift towards higher temperature range[12]. The major mass loss for all the samples occurred in the range of 290-320°C. However specific peak related to the different ratios of the hydrogels cannot be clarified.

3.4 Swelling properties

The prepared hydrogels were studied for the water uptake and swelling behavior using DI water. The effect of variation of concentration of PVA in the prepared samples is evident from the recorded values of water uptake of all the samples. All the samples have optimal water uptake confirming suitability for application in tissue regeneration. Swelling in all the hydrogels irrespective of the concentration of SF and PVA can be seen to attain equilibrium within 24 hours of study. The samples were prepared using 2% concentration of PVA show higher water uptake than 5% or 10% PVA samples. Thus increasing the concentration of PVA decreases the water uptake of the hydrogels. PVA increase the overall cross linking density in the samples thus reducing the water uptake[13][7].
3.5 Mechanical properties

As the concentrations of PVA in the prepared hydrogels increase, there is an increase in the tensile strength and elongation. There is an increase in polymer crystallites as the PVA increases. The hydrogen bonding in the PVA is higher and thus results in physical cross-linking. These factors play an important role in the increase in the overall strength of the hydrogels as the concentration of PVA increases[14].

3.6 Porosity

Table 3 depicts the porosity measured by liquid displacement method of the SF/PVA hydrogels. All the prepared hydrogels have optimum porosity as per the requirement of any tissue engineering scaffold. All the prepared hydrogels have more than 70 % porosity as recorded. This is an acceptable range of porosity for cell infiltration and proliferation[15]. As the PVA content of the prepared hydrogels increases there is overall increase in porosity. As the content of PVA increases, the hydrogen bonding increases. Thus the larger pores are deformed and formed in smaller pores thus increasing the density of pores which can be substantiated by the SEM results below. Due to increased pore density, the overall porosity of the hydrogels is increased as the PVA content increases. [15][16].

Table 2: Tensile strength and % Elongation of SF/PVA hydrogels

<table>
<thead>
<tr>
<th>5 % RSF/2 % PVA</th>
<th>Tensile Strength</th>
<th>% Elongation</th>
<th>5 % RSF/5 % PVA</th>
<th>Tensile Strength</th>
<th>% Elongation</th>
<th>5 % RSF/10 % PVA</th>
<th>Tensile Strength</th>
<th>% Elongation</th>
</tr>
</thead>
<tbody>
<tr>
<td>80/20/2</td>
<td>7.85</td>
<td>4.94</td>
<td>80/20.5</td>
<td>8.25</td>
<td>10.04</td>
<td>80/20.10</td>
<td>8.75</td>
<td>16.82</td>
</tr>
<tr>
<td>60/40/2</td>
<td>8.12</td>
<td>10.39</td>
<td>60/40.5</td>
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<td>13.5</td>
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<td>11.41</td>
<td>25.44</td>
<td>20/80.10</td>
<td>11.75</td>
<td>31.25</td>
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</table>

Table 3: Porosity of SF/PVA hydrogels

<table>
<thead>
<tr>
<th>5 % RSF/2 % PVA</th>
<th>Porosity</th>
<th>5 % RSF/5 % PVA</th>
<th>Porosity</th>
<th>5 % RSF/10 % PVA</th>
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<td>75</td>
<td>80/20/10</td>
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<td>60/40/5</td>
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</tr>
<tr>
<td>40/60/2</td>
<td>89</td>
<td>40/60/5</td>
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<td>20/80/2</td>
<td>89</td>
<td>20/80/5</td>
<td>91</td>
<td>20/80/10</td>
<td>96</td>
</tr>
</tbody>
</table>
3.7 Scanning Electron Microscopy

Figure 5: SEM of freeze dried SF/PVA/2 (40/60/2) at magnification 1200X

The average pore size among the samples was in the range of 20-50 µm. There was uniformity observed in the distribution of pores throughout the hydrogels. The density of the pores is directly related to the concentration and composition of the ingredients with respect to water as the freeze drying process involves the movement of water among the polymer matrix. As the concentration and the total dissolved solids in the water increase, the movement of the water during freeze drying process is obstructed. As the concentration of PVA increased in the hydrogels, the viscosity of the solution increased. Thus during the freeze drying process the trapped water in the hydrogels forms small crystal nuclei rather than large ice particles. Thus as the concentration of PVA increase the samples will show less pore size and higher pore density[17].

3.8 In-vitro degradation

The role of any cross-linking agent whether physical or chemical, is to increase the holding duration of the scaffold in the required shape and size as per the requirement of the tissue under repair. The study of this duration is performed in-vitro using different degradation mediums which correspond to the in-vivo environment thus giving a brief idea of the behavior of the scaffold when implanted in the destined tissue. The prepared hydrogels were explored for degradation in PBS, SBF and enzymatic environment and the weight loss was recorded. The study was conducted for 7 weeks. The recorded weight loss of the hydrogels is represented in the graphical form in the figure 6. Since there was no chemical cross-linking agent used in preparation of hydrogels, most of the samples were degraded up to 100 % over 7 weeks period. However, out of the 12 different compositions of the hydrogels prepared, 2 of the samples gave immediate disintegration of the structure within a week's time. All the rest of the hydrogels displayed gradual degradation in the form of weight loss thus showing a stable structural degradation and thus can give enough time frame maintaining structural integrity for their application in the regeneration of the tissue[18].

Hydrogels having higher concentration of PVA were degrading slowly than the samples having higher concentration of SF. SF enhances the oxygen and solvent penetration which induced higher degradation rate[19]. Though PVA chains physically interact with SF through weak molecular forces i.e. hydrogen bonding when the samples are exposed to the degradation mediums; due to the hydration between PVA and H2O, the PVA chains with weak molecular forces in the network overcomes the intermolecular interaction and thus gradual separation is initiated from the hydrogel samples. Thus PVA component in the hydrogel gets degraded over time and facilitate more fluid diffusion[20]. This process lasts for a period over 7 weeks which can be helpful for a slow and controlled release of the any drug loading studies[21].

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All TAI Members

THE TEXTILE ASSOCIATION (INDIA)

Please update their contact information by
Sending us e-mail to update our mailer data
taicnt@gmail.com
4. Conclusions
The study generates and summarizes a cumulative database using two established biomaterials PVA and silk fibroin. The freeze-drying technique is used for preparation of SF/PVA hydrogels without the use of any additional cross-linking agent. The prepared hydrogels were tested and demonstrated that hydrogels prepared with different ratios of SF/PVA have the essential characteristics for tissue engineering in terms of fine structure, morphology, uniform distribution of pores and structural stability during the in-vitro degradation. The characterization of hydrogels using FTIR, TGA and XRD demonstrated the interactions between the two biomaterials used. The inferences lead to the conclusion that as the concentration of PVA is increased in the hydrogels, pore density and crystallinity is increased and thus increasing the mechanical strength and dimensional stability. Absence of chemical cross-linking agent did not negatively affect the properties of the prepared hydrogels. Results of the study can be directly implemented for the use in medical field thus using an industrially feasible technology and well established biomaterials. Thus, the research can open up new avenues for the preparation of scaffolds without chemical cross-linkers eliminating the possibility of loss in cell activity during tissue regeneration.

References

Figure 6: Degradation profile of SF/PVA hydrogels prepared studied in PBS (a, b, c), SBF (d, e, f) and enzyme (g, h, i)

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  - Cover 3
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  - A-4
- ITME AFRICA
  - A-2
- Lakshmi Machine Works
  - A-1
- OPPORTUNITY FOR TEXTILE
  - A-6, A7

- Precision Rubber Ind. Pvt. Ltd.
- Reliance Industries Ltd.
- Rieter India Ltd.
- Rieter India Ltd. (Components)
- Advertise with Us
- Trutzschler India

- A-8
- Cover 1
- A-3
- Cover 2
- Gate Fold
- P-
- A-5

November - December 2019
Graphene-based Cotton Fabric for Multi-functional Finishing

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Abstract
The development of functionalized cellulosic textiles like cotton, with a prior focus to an eco-friendly approach is currently the most recent topic in the field of textile processing. In the present research work a highly facile and eco-friendly green process for multi-functional finishing of cotton has been adopted by the reduction of graphene oxide (GO) treated cotton fabric. The characterizations of prepared graphene-based cotton fabric include Fourier-Transform Infra-red Spectroscopy (FTIR), X-ray Diffraction (XRD), Thermogravimetric Analysis (TGA), and Scanning Electron Microscopy (SEM). Removal of oxygen-containing moieties from the GO was confirmed by FTIR spectra. The X-ray diffractogram confirms the formation of graphene-based cotton (G-cotton). The Scanning Electron Micrographs depict the effective reduction of GO onto a cotton fabric. All characterization tools clearly reveal that the G-cotton has been successfully prepared. Flame retardant properties of the untreated and the treated cotton fabrics are analysed by Limiting Oxygen Index (LOI). The study shows that the graphene-based fabric has a good flame resistance property compared to that of the untreated and GO treated fabric. Very good antimicrobial activity against Escherichia coli and Staphylococcus aureus is also observed along with an excellent ultra-violet protection.

Keywords

1. Introduction
In today's era of modernization, almost all the textile sectors are witnessing innovations and its positive effects all around. Functional textiles are one of such fields which are presently rising above rapidly. Protective textiles are also result of such smart technological advancements. Textiles in fabric form offer potential advantages as compared to traditional sheet materials like high surface area, mechanical properties, flexibility, etc. that can make them attractive substrates onto which other functional materials can be deposited.

Graphene has emerged as a revolutionary material in the field of material science and physics due to its extraordinary properties. It is known to be a wonder material owing to its unprecedented advanced properties in various sectors like electrical, mechanical, thermal, optical, etc. since its discovery [1, 2]. The applications of such material can be made in UV protection, conductive fabrics, antistatic fabrics, hydrophobicity, sensors, heat generation, thermal conduction, photocatalysis, electrolytic activity, antimicrobial, solar cells, field emission devices, energy storage, etc. One of the widely acceptable methods of synthesis of graphene is the Chemical Exfoliation method. It involves the synthesis of an intermediate oxide form of graphite popularly known as graphene oxide (GO) by an oxidation process followed by the reduction of GO into graphene (G) [3]. The method is popularly known as Modified Hummer's method [4].

The limitation of reduction process of GO is the high toxicity of reducing agents like dimethyl hydrazine, hydrazine hydrate, sodium borohydride, hydroquinones, etc. Traces of these toxic reducing agents could have detrimental effect to humans as well as environment. Considering such troubleshooting, we have developed a greener route for the reduction of GO in order to overcome along mentioned problem. In the present research work, graphene oxide (GO) is coated on the cotton fabric and the as prepared GO treated fabric is subjected to a natural reducing agent for the preparation of graphene-based cotton (G-cotton) by an exhaust process. In this work, a greener sustainable pro-
toccol is employed to reduce GO onto the textile substrate itself which particularly prevents aggregation of graphene layers after forming. The prepared G-cotton has shown good multi-functional properties.

2. Materials and methods

2.1. Materials

Natural Graphite flakes were obtained from S D Fine-Chem Ltd., Mumbai, India. Potassium permanganate (KMnO₄), Conc. Sulphuric acid (H₂SO₄) (95-98%), Hydrogen peroxide (H₂O₂) (50%), Sodium nitrate (NaNO₃) (98%), Conc. Hydrochloric acid (HCl) and all other organic solvents were received from Merck. Ready for dyeing (RFD) cotton fabric of 220 g/m² was supplied by TATA Mills, Mumbai, India. Natural reducing agent: Garcinia indica concentrate was procured from the local market of Dadar, Mumbai, India. For antimicrobial testing, Gram-positive bacteria Staphylococcus aureus (S. aureus) and Gram-negative bacteria Escherichia coli (E. coli) were procured from KEM Hospital, Parel, Mumbai, India.

2.2. Methods

2.2.1. Synthesis of Graphene oxide (GO)

Initially, the graphene oxide (GO) was prepared from graphite through modified Hummer’s method [5]. Conc. H₂SO₄ (69 mL) was added to a mixture of graphite flakes (3 g, 1 wt equiv.) and NaNO₃ (1.5 g, 0.5 wt equiv.) and then cooled to 0°C with constant stirring. KMnO₄ (9 g, 3 wt equiv.) was added slowly in small fractions. The reaction was further stirred at 35°C for 30 min and then, water (150 mL) was poured into the reaction mixture, and at this time, an exotherm was observed which increased the reaction temperature up to 98°C. The reaction mixture was further heated for 15 min in an oil bath to maintain the same temperature and then cooled for 10 min. Excess water (350 mL) and H₂O₂ (3 mL) were added and stirred for another 15 min. The final yellow-brownish precipitate was filtered, washed several times with distilled water and finally vacuum dried to obtain GO.

2.2.2. Preparation of Graphene oxide coated cotton fabric (GO-cotton)

The RFD cotton fabric was soaped with a non-ionic detergent at 80°C for 30 mins and kept overnight for drying. A 10% aqueous solution of GO in distilled water was pre-sonicated for half an hour. The as prepared GO solution was further considered for carrying out the treatment on cotton fabric. The cotton fabric was both side coated with the GO followed by its drying at 80°C for 5 mins and curing at 120°C for 3 mins in a hot air stenter.

2.2.3. Reduction of Graphene oxide coated cotton fabric (G-cotton)

Various concentrations of the natural reducing agent were prepared at levels of 2%, 4%, 6%, 8%, 10%. The GO coated cotton fabrics were treated with the as prepared aqueous solutions of the reducing agent at 80°C for 2 hrs considering material to liquor ratio (MLR) of 1:30. The treated fabrics were further subjected to washing, air drying and kept for conditioning for further testing and characterizations.

2.2.4. Fourier Transform Infra-red Spectroscopy (FTIR)

The FTIR spectra of the untreated and treated specimens were recorded using pike miracle ATR module with diamond/ZnSe crystal on FTIR spectrometer (Shimadzu 8400S, Japan) by recording 45 scans in % Transmittance mode in the range of 400-4000 cm⁻¹.

2.2.5. X-ray Diffraction Analysis (XRD)

XRD analysis of the untreated, GO-cotton, G-cotton specimens were carried out on Shimadzu 6100 model equipped with CuKa radiation (λ=1.54 Å) in the 2θ range from 5 to 50°. Generator voltage was kept at 40 kV, and the generator current was 30 mA, in a step of 0.02°.

2.2.6. Thermogravimetric Analysis (TGA)

The untreated and the treated cotton fabrics were cut into small pieces, and TGA was carried out. The thermograms were recorded on Shimadzu 60H DTG apparatus in the temperature range of 30-600°C with a heating rate of 10°C/min under an atmosphere of nitrogen at a flow rate of 50 ml/min.

2.2.7. Scanning Electron Microscopy (SEM)

The surface morphology of the untreated and treated specimens was analyzed using Field Emission Gun-Scanning Electron Microscope ((FEG-SEM, TESCAN). Specimen size of 5 × 5 mm² was taken and the conductive agent used was platinum, sputter coated for 600 sec duration. The beam voltage of 10 kV, 1000X magnification and 6 mm working distance for examining the specimen were maintained throughout the run.

2.2.8. Flammability Assessment

Standard methods were used for evaluation of the burning behavior of both untreated and treated specimens. For the determination of flammability by Limiting Oxygen Index (LOI) analysis, IS 13501:1992 for
textiles test procedure was adopted. As per standard, flame contact time was kept as the 30 s; specimen size was $6 \times 4$ cm$^2$; oxygen and nitrogen flow meter in cm$^3$/min was set as per LOI value with a 38 mm length of the flame. The results are expressed as:

$$\text{LOI}(\%) = \frac{O_2 + N_2}{O_1} \times 100$$

2.2.9. Ultra-violet Protection Factor (UPF)
The UPF values of the untreated, GO-cotton and G-cotton fabrics were measured using a Shimadzu UV-2600 spectrophotometer in the range of 280 to 400 nm. The UPF value of each fabric was determined from the total spectral transmittance based on AS/NZS 4399:1996 method.

2.2.10. Antimicrobial Activity
The antimicrobial activity of the untreated and treated cotton fabrics was quantitatively evaluated against E. coli (ATCC 25922) and S. aureus (ATCC 25923), according to the AATCC 100 test method. Colonies of bacteria recovered on the agar plate were counted, and the reduction of bacteria (R), % was calculated by the following equation:

$$R(\%) = \frac{(B - A)}{B} \times 100$$

where, $A$ is the number of bacterial colonies from treated specimen after inoculation of 24 h contact period and $B$ is the number of bacterial colonies from untreated specimen after inoculation (at "0" contact time).

3. Results and discussion
3.1. Fourier Transform Infra-red Spectroscopy (FTIR)
FTIR spectra of the untreated cotton, GO-cotton and G-cotton are illustrated in Figure 1. The reduction of the oxygen-containing groups in GO was confirmed by FTIR spectroscopy. The FTIR spectra of GO-cotton in Figure 1 (b) showed a strong transmission band around 1632 cm$^{-1}$ due to the C=O stretching. The spectrum of GO also exhibited the presence of O-H at 3448 cm$^{-1}$ and 1398 cm$^{-1}$, C=C at 1632 cm$^{-1}$, and C-O at 1095 cm$^{-1}$. As shown in Figure 2 (c), the characteristic transmission bands of oxygen containing moieties in O-H, C=O, and C-O decreased dramatically, indicating the reduction GO-cotton to G-cotton [6].

3.2. X-ray Diffraction Analysis (XRD)
X-ray diffractograms of the untreated cotton, GO-cotton and G-cotton are illustrated in Figure 2. The graphene oxide coated cotton exhibited a sharp peak at a lower 2$\theta$ value (10.16°) which is the characteristic peak of GO [7]. After reduction of the GO-cotton, the aforementioned peak completely disappeared. The G-cotton didn't show any peak around 10$^\circ$ thereby inferring a complete exfoliation of graphene oxide layers during the reduction process. In the XRD pattern of the G-cotton, this peak disappeared, and the peak around 22-23$^\circ$ got intensified which indicates the reduction of the GO and the formation of graphene onto the cotton substrate.
3.3. Thermogravimetric Analysis (TGA)
From the Thermogravimetric behaviors of the untreated cotton, GO-cotton and G-cotton fabric as illustrated in Table 1 and in Figure 3, it could be found that G-cotton showed 79.735% of mass loss whereas the untreated cotton and GO-cotton showed 91.286% and 90.286% respectively, after 600ºC. Though the degradation point laid somewhere earlier than the untreated and the graphene oxide coated cotton, the residual mass of the graphene based cotton was more thereby indicating better thermal stability.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cotton (a)</th>
<th>GO-cotton (b)</th>
<th>G-cotton (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start (°C)</td>
<td>28.32</td>
<td>28.94</td>
<td>29.09</td>
</tr>
<tr>
<td>End (°C)</td>
<td>600</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Mid Point (°C)</td>
<td>355.40</td>
<td>363.19</td>
<td>331.13</td>
</tr>
<tr>
<td>Onset (°C)</td>
<td>355.06</td>
<td>380.68</td>
<td>462.40</td>
</tr>
<tr>
<td>Endset (°C)</td>
<td>381.63</td>
<td>385.27</td>
<td>359.97</td>
</tr>
<tr>
<td>Mass loss (%)</td>
<td>-91.286</td>
<td>-90.286</td>
<td>-79.735</td>
</tr>
</tbody>
</table>

3.4. Scanning Electron Microscopy (SEM)
Scanning Electron Micrographs of the untreated cotton fabric depicts clear and smooth fibre as shown in Figure 4 (a). In case of graphene oxide coated cotton, deposition of the coated layer has been observed which got almost disappeared after the reduction of the graphene oxide coat on cotton as shown in Figures 4 (b) and (c) respectively.

3.5. Flammability Assessment
Being cellulosic in nature, untreated cotton fabric showed Limiting Oxygen Index (LOI) value of 18, reflecting easy flammability of the substrate. Any material showing LOI value equal or more than 26 could be considered to be as a fire retardant. The LOI values of the untreated, GO and G-cotton fabrics at various levels of concentrations of natural reducing agent are illustrated in Table 2. After the application of graphene oxide onto the cotton substrate, the LOI value was found to increase significantly. When the fabric was coated with GO, the LOI value was found to increase to 28 which is almost 55.5% higher than that obtained for the untreated fabric. When the graphene oxide coated fabrics were reduced, the LOI value increased to 32 which is almost 77.78% higher than the untreated cotton.

<table>
<thead>
<tr>
<th>Flammability parameter</th>
<th>Cotton</th>
<th>GO-cotton</th>
<th>G-cotton</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOI</td>
<td>18</td>
<td>28</td>
<td>25</td>
</tr>
</tbody>
</table>

3.6. Ultra-violet (UV) Protection Property
The ultra-violet protection factor (UPF) values of the untreated cotton, GO-cotton, and G-cotton fabrics are shown in the Table 3. UV radiation is responsible for
major causes of degradation of textile materials owing to its very large surface-volume ratio. The application of graphene oxide and its reduction onto the cellulosic substrate like cotton resulted in an achievement of excellency in the protection against the harmful UV rays as observed through the UPF ratings. The UPF values obtained for the treated specimens were found to exceed 50 (actual value very high) which suggests that the dark color obtained due to the graphene oxide and graphene induces higher absorption of UV radiations.

Scanning Electron Micrographs confirmed the deposition of graphene oxide on the cotton fabric as well as its conversion to graphene after its reduction onto the cotton substrate. The formation of such graphene-based cotton fabric could offer multi-functional properties possessing good fire retardancy, excellent ultraviolet protection along with a very good resistance against bacteria. The effect of washings on such kind of value additions to the cellulosic textiles like cotton with a concern to durability is to be covered up in the further scope of this research work.

### Table 3: Ultra-violet (UV) Protection of untreated cotton, GO-cotton, and G-cotton

<table>
<thead>
<tr>
<th>Flammability parameter</th>
<th>Cotton</th>
<th>GO-cotton</th>
<th>G-cotton 2%</th>
<th>G-cotton 4%</th>
<th>G-cotton 6%</th>
<th>G-cotton 8%</th>
<th>G-cotton 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPF</td>
<td>24.4</td>
<td>50+</td>
<td>50+</td>
<td>50+</td>
<td>50+</td>
<td>50+</td>
<td>50+</td>
</tr>
</tbody>
</table>

### Table 4: Antimicrobial Activity of untreated cotton, GO-cotton and G-cotton

<table>
<thead>
<tr>
<th>Type of Fabric</th>
<th>Quantitative Test (AATCC 100) Bacterial reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S. aureus</td>
</tr>
<tr>
<td>Cotton</td>
<td>No reduction</td>
</tr>
<tr>
<td>GO-cotton</td>
<td>85.91%</td>
</tr>
<tr>
<td>G-cotton</td>
<td>99.32%</td>
</tr>
</tbody>
</table>

### References

Inventory - a Tool for Productivity

Introduction

A housewife in her very deceptive ordinariness is exceptionally extraordinary in managing her kitchen inventory. It's almost everywhere; what quantum required for cereals, milk, vegetables, salts, sugar, cooking oils, ghee, spices, fruits, dry fruits, cooking gas etc. She estimates monthly budget and sets quantum of each and every required item, sets purchase schedule to make it cheaper in cost, better in quality and practically no waste. The complex decision indeed depends on wholesome knowledge and experience about quality, taste, durability, availability, storing facility, cost, payment and real consumption. The perfection comes through day-night experiences by the lady just from her childhood and it grows confidently and constantly parallel as she grows up. She knows green vegetables available to her in market and how long it can last. She knows the particular pulse will last up to the particular period and also she knows how it should be stored. She has similar experience with milk, fruit and other daily needed items. She also has procurement ideas; what to be purchased, when to be purchased and how to down size cost for absolute quality she needs. Not more, she also knows how to use by-products and remains of kitchen reparations. Really a silent control, isn’t?

In textile industry, inventory plays a major role for productivity. Inventory manager should actuate ideas just in style of a housewife managing her kitchen inventory. If one look into one’s kitchen will certainly find basic formulae for inventory control. Various persons responsible for different inventories like raw -materials, machinery spares, store’s consumables etc. have to plan purchases and storage as per need and the best if ‘just-in-time’ reach. For example fibre bales reaching the spinning mill if now be immediately rushed to mixing and blow room as needed. A yarn bag should reach loom shed or greige fabric to process house just-in-time, allowing no waiting time and as such inventory moves towards zero. Only emergency stock for product -mix should be kept there if required for contentious process. The same is in case of stores and spares or packing materials like sacks, bags, cartons etc. But all the practices require planning and proper actuation and the most important co-ordination among all working groups and subsequent processwise production people. The needs, services and essentials be planned, replanned and monitored time to time for each and every production unit. Rejection, wastage, re-use, purchase and repurchase should be done in planned way but making all possibility for just-in-time. Time and again schedules should be altered and re-altered as per need.

To focus on the subject a few guidelines are being explained further under various captions;

Raw Materials

Various raw materials for textile industry as under,
Spinning mills - cotton or synthetic fibre bales,
Weaving mills/ Hosiery mills, yarn bags,
Process house - Greige cloth
Garment units - semi- finished or finished fabrics

Management has to decide qualitywise minimum requirements as per sales and supplies. Purchase orders be made looking to all elements like price,
availability, quality assurance, lead time for supply etc. etc. With all surities management must re-assure the reach of the raw materials to mills just before needed for production. Time reduced for purchase, storage, production and supply drastically reduces cost of product. Orders may be placed for fibre, yarn and fabric for a month, two months or even for a year but supplies should be scheduled as per just-in-time reach so that material received at godown is immediately taken into production. It is possible only if mutual understanding exists there between buyer and seller. Also, if needed changes in supply schedule or reschedule be effected without hampering business relations. Applying mind, some inventory managers are smart enough to maintain raw materials stock just for seven days or even less days production.

Stores
In textile mills many consumable items are required from sweeping brooms, cleaning powder to electric bulbs, machinery spares and electric motors etc. There are broadly two section of stores items as per availability, locally available or to be purchased from outside, within country or to be imported. Local based items can be purchased on daily or weekly basis in numbers looking at cost effectiveness and storage facility. Items to be purchased from outside one has to take quotations from different suppliers, to calculate collection charges, to confirm quality parameters, payment terms etc. and to assess lead time accordingly.

Next purchase should be actuated by trial order, confirm orders with proper schedules but with a provision of reschedule, postponement or preponement of supplies as and when needed.

Spares
Machines require regular maintenance to keep up machines in sound health and accordingly preventive maintenance is scheduled for oiling, greasing, cleaning of all parts and replacement of every wear-n-tear parts. Certain parts are also required to be changed for conformity of production parameters or for alter in product line.

Also, as such spare parts are regularly required and hence it's essential to maintain a minimum stock of spares. Those are mostly available from machinery manufacturers and also available in open market. Electrical components, motors, driving belts suitable pulleys are also needed either due to failure or for change in product mix. One must keep vigil for genuine spare parts. Sincerity of suppliers must be judged time and again. Even paying higher price for correct spares rests the purchase cost effective. Regular feedbacks from various sources and data collection regarding availability, cost supplies should be maintained update. Of late, it is easier due to quick information, e-mail site logging and study, your fingers on mouse, data on screen of your computer, eyes on sites and mind set for catches.

Storage
Storage of various items needs a very systematic and scientific approach. Being in different physical and chemical properties, items to be stored shouldn’t harm one another and should be easier to carry out the materials to working site. For example, fibre bale godown should be adjacent to mixing room so that mixing men can collect fibre at the time of mixing easily and in no time. And if the godown is away, extra hands are required for collection of the bales. Similarly yarn stock should be near loom shed or near the warping area or knitting machines. Starch and other ingredients for sizing should be near the sizing machines. All maintenance rooms and accessories must be adjacent to respective workplaces. Finished goods godown be nearer cone winding section in case of spinning mill, adjacent to loom shed or knitting machines in case of greige fabric and nearer to folding section in case of finished fabrics. Practically, excise godowns should be adjacent or very nearer to packing, folding and stamping locations.

Technology
Technology means application of science to the solution of problem. It enables human beings to regulate their environment. Technology is not merely a matter of machines or microchips. It’s not a matter of interest only for scientists and laboratories. We have entered into an era in which technology is power, technology is wealth and control over technology is a source of influence and power. Welcome technology with arms wide open. Use of information technology like e-mail and site-log can be used to reduce inventory. Purchase order processing expenses are extremely reduced to a bare minimum. Most important expenditures and time consumed in postals, telephone etc. are further reduced by e-mail and site logging.

Human Order
The problem of inventory control in textile industry is, therefore, of considerable importance. Policies of inventory control in a firm may be complex but essential principles are straight forward. On pattern of material order formula “A place for everything and everything in its place.” “A place for everyone and everyone in his/ her place.” Integrated approach on these lines will certainly have productive impact on material management. A manager must be able to have creative ideas generated at any level and utilise those to control inventory. If inputs and outputs, that is, purchase, sales and services are well planned beforehand there is no reason far inventory not being led towards zero. There will be no need of adjec-
tives like minimum, optimum, controlled or model as for as inventory is concerned. And there comes the human order. Think it again.

Consciousness
A person in business may feel uneasy about survival in this competitive world without keeping some inventory of raw material, work in process, products and spares. This type of hoarding, however he is no longer practical. Industry must develop courage or rather the common sense to procure what is needed, when it is needed and in what amount needed. It requires a revolution in consciousness, a change of attitude and viewpoint. Holding a large inventory causes waste. It also leads to an inventory of detectives which is really a loss. We must understand these situations in depth before we can reach a revolution in consciousness.

Waste
In production waste is referred to all elements of production other than product waste or process waste and that only increase cost of product without adding any value, excess people, excess inventory and exceeds equipment. Too many people, equipment and product only increase the cost by creating secondary waste. With too many workers unnecessary work is generated which in turn increases usage of power and materials. This is secondary waste. The biggest waste of all is huge inventory to store. It needs more space, more worker and time. Again more expenses and therefore higher cost of product. So all type of waste should be eliminated to reduce cost and inventory should be taken near zero.

Side Effects
Higher inventories invite problems like theft, corrosion, deterioration in quality characteristics etc. Iron and steel items get corroded due to moisture and rusting. Chemical and dyes ooze out their intensity. Salts get moistened and damage other materials lying in vicinity.

Rubber and leather items need special attention. Rubber cots and aprons get ozoniged dimensionally distorted in adverse climatic conditions. Such items better be stored in dark room and that too in below room temperature. Colour and chemicals should be stored in separate area. Ageing effects cannot be ruled out on certain items like adhesives, greases, oils, soaps etc. Accidents like fire, building collapse, theft, heavy rain and havoc are also detrimental if inventories are huge.

Transit Inventory
Now it is high time to believe in transit inventory and to practice it. Material procurement should be as such that as soon it reaches factory it can be taken into production line. There is a fact to believe that iron ore from mine is converted into a car running on road within three and a half days, practically made possible by Henry Ford, America, a very good example of transit inventory. It also proves no inventory process.

Just --in--time
It is much more than inventory reduction. It's much more than modernising the factory. It's, in senses, making a factory operate for the company just like the human body operates for an individual. The human body functions in good health when it is properly cared for, fed and watered correctly, exercised regularly and treated with most respect. It's a unique concept.

Just-in-time means that in a princess flow the right materials needed reach in process at the time those are needed and only in the needed amount. A company establishing such type of process flow throughout can achieve zero inventories. From point of view of production management it's an ideal state. With a better tool we can get wonderful results. But if we use it incorrectly, the tool can make things the worst. Just-in-time is a type of tool that when used improperly can cause variety of problems. An upset in production, mistake in planning, defective products, reprocess, trouble in and with machinery and equipment, absenteeism problems are countless. A problem early in the process always results in a defective product later in the process. As such there may be production line stoppage or change in plan whether management likes it or not. Conventional management doesn't work here. The word "just in" "just-in-time" means exactly that if material reaches any time prior to it's need not at the exact time it needed waste cannot be eliminated. Therefore use of JIT system must be implemented correctly and if so there is no need of extra inventory, there is no need of warehouse and it's manager. Generation of countless papers also becomes obsolete. Once decided upon it should be taken with firm and determined mind and see miracle happens; increase in efficiency and reduction in almost all type of waste- primary and secondary.

Disposal
There are following types of disposals which make a part of inventory;

a) Process waste which can't be recycled,
b) By-products
c) Defective products
d) Package waste
e) Retired machine parts and consumables.

There should be daily, weekly or monthly schedule for sale of disposable items depending upon quantum. Process waste should be sold out immediately as and when saleable package been ready. By-products should be on regular sale programme and it should be chalked out with production plan of main product.
As by its meaning, a by-products product is a produce while processing of the main product. The defective goods should be cleared on reduced rates. In case of fibre it can be sold out with Sun-Times standard coding. Similarly defective yarn can be sold out to low quality consumers with claimed quality tags. Defective cloth can made seconds, fents or chindi and cleared on lower rates. Ready-made garments not conforming to standard quality can be channelized to move in market away from standard sale area, better without usual brand. Certain items like plastic materials in form of sheets, paper packages, cartons, iron boxes, wooden cases etc. should be cleared separately quality wise with value engineering concept. Instead of mix-up of all items, those should be sorted out, kept separately to realize maximum price. Same methodology should be adapted for disposal of used, worn-out and damaged machinery parts and stores consumable items like card cans, Bobbins, reeds, healds, gears, runner-up blankets, motors, pulleys, belts, ropes, tube lights, bulbs, etc. Unusable office and utility items like furnitures, fans, air-conditioners, telephones, computer, table glasses, utensils, crockeries etc. should be cleared out on routine basis.

Focus
The aspects briefed above are a few examples and are concerned to a few segments only like raw materials, stores, spares, storage, technology, human order, consciousness, waste, side impacts, transit inventory, just-in-time and disposals. Your kitchen core impact for keeping your house in healthy condition with near zero inventories. Not only A, B, C, for inventory management starts from your kitchen but a total solution is there. Only you have to search it.
The series of chapters under the title, 'Graphene A Wonder Material' are being published in the Journal of the Textile Association. The nanomaterial Graphene has been attracting a lot of attention over the past few years. Thankful to its unique combination of a simple structure of bonded carbon atoms with its multitudinous and complex physical properties. This series covers the extraordinary features of graphene, its different methods of preparation and isolation, useful applications in various fields of science and technology, its science involved in the technology of textiles, and finally ending up with its future prospects.

This series is written primarily as an introductory text for the readers of those interested or already working in graphene and putting up its essence in the textile related areas, who wish to acquire a broad knowledge of graphene and its application in textiles.

The previous chapter threw some insights upon graphene based membrane and its various potential applications. The preparation methods of graphene oxide membrane were reviewed, including vacuum suction filtration, spray coating, spin coating, dip coating and the layer by layer method. The development and application of graphene based membrane in water treatment were briefly discussed.

The present chapter presents the latest theoretical and experimental studies over versatilities of graphene and its derivatives for carbon capture. Imposing effective carbon dioxide remediation strategies as one of the top urgencies of 21st century requires state-of-the-art materials development and graphene could play a game-changing role in this regard.

**Chapter 17**

**GRAPHENE A WONDER MATERIAL : CO₂ Sensing**

*Saptarshi Maiti, Pintu Pandit, Geetal Mahajan, R. V. Advarekar & M. D. Teli*

**Graphene** has been used for many major applications, particularly: (i) in energy-related areas, modified graphene materials have been used in solar cells while metallic/metal oxides in combination with graphene are utilized in lithium ion batteries, super-capacitors, and fuel cells; (ii) in the environmental pollution remediation area, graphene and magnetic graphene nanomaterials have been employed as adsorbents for heavy metal ions and organic pollutants, while several transition-metal oxide graphene hybrids are studied for the degradation of toxic organic pollutants. Graphene-based materials have been also examined as the pollutant sensors including CO₂ sensing applications.

Energy and environmental issues are two of the major challenges facing modern civilization by the mid-century. From this perspective, fossil fuels are double-edged swords that require a delicate balance between their benefits and drawbacks. They are undoubtedly versatile energy sources; where oil and natural gas supply close to 90% of our current energy requirement comes from, making so many industrial activities economically feasible. The adaptabilities offered by the carbonaceous fuels have still preserved their importance as the main source of energy for a wide variety of applications. Firstly, they are available in a wide range of physical states (gas, liquid and solid) spreading almost worldwide. Secondly, myriad of technological advances are made with respect to their implementation for various applications in different scales. Thirdly, owing to high energy density and portability, their superior properties as fuels in transportation industry cannot be overstated. The increasingly alarming climate change issues have occurred due to notable amounts of carbon dioxide emissions from undue consumption of fossil fuels. Burning nearly 1 g of carbon in fossil fuels could release more than 3.5 g of carbon dioxide (CO₂), accumulation of which is now approaching 1 Tt in the atmosphere.

Long-term solutions to address the aforementioned problems are based on the development of sustainable alternatives for quenching the ever-increasing human energy thirst. Meanwhile, in the current fashion of runaway fossil fuel intakes, CO₂ reduction strategies particularly from large-scale energy consumers rely mainly upon three proposed generic solutions for CO₂ capture and storage (CCS): pre- and post-combustion capture, and oxy-fuel combustion. Afterwards, the purified CO₂ is sent for physical storage options such as deep ocean sequestration, geological storage, limited industrial uses, etc. However, researchers believe that storing CO₂ somewhere other than atmosphere is not the permanent solution to the problem. In fact, the long
term ecological and environmental impacts of using the earth as a gigantic reservoir for carbon dioxide are not well understood. The potential hazards of CO₂ leakage to the earth surface remarkably increase the risk of this approach. Based on the facts stated above, chemical transformation of CO₂ can be a realistic solution to the CO₂ sequestration concerns; which could ultimately lead to the utopia for fossil-fuel-based economies with taking full advantage of the carbonaceous fuels while minimizing their negative environmental impacts. This approach of recovering CO₂ in order to synthesize useful products is capable of sustainable reduction of carbon emissions, and is known as carbon capture and conversion (CCC). The economic advantages of producing valuable chemicals from CO₂ provide further incentives for major emitters to move towards this direction.

Graphene, as the rising star of the materials world in 21st century, offers game-changing prospects towards a more sustainable future for fossil fuel based economies. This two dimensional planar sheet of sp²-bonded carbon atoms is the most widely studied nanomaterial since its discovery in 2004 by Sir Andre Geim and Dr. Konstantin Novoselov. Considering its enormous unique properties, graphene can be implemented promisingly within many areas of energy and environmental research. It has a large theoretical specific surface area (~2630 m²g⁻¹), high intrinsic charge mobility (~200,000 cm²v⁻¹s⁻¹), strong Young’s modulus (~1.0 TPa), and excellent thermal conductivity (~5000 Wm⁻¹K⁻¹), while having significant optical transmittance (97.7%) for application as transparent conductive electrodes.

Recently, relatively high uptake of hydrogen and carbon dioxide by rGO sheets with a wide range of surface areas is reported. A reasonable hydrogen uptake of 1.7 wt% was observed at 1 atm and 77 K, where the values were linearly correlated with the surface area. Thus, upon extrapolation, the hydrogen uptake by single-layered graphene was projected to exceed 3 wt%. The H₂ adsorption at 100 atm and 298 K was found to surpass 3 wt%, which suggests much higher uptakes by the mono-layered graphene via linear extrapolation. On the otherside, rGOS showed remarkably higher uptakes for CO₂, approaching 35 wt% at 1 atm and 195 K. This was further backed by another study on rGOS obtained from various thermal reduction conditions showing high CO₂ capture capacities (248 wt% under 298 K and 30 bar). Such uptakes were significantly higher than those for commercial zeolites (7-fold) and activated carbons (3.5-fold) under similar experimental conditions.

A few theoretical works have explored the determining role of edges on the physicochemical properties of nanographenes as they contain numerous edges with various types of defects. The edges contribution to the molecular adsorption by graphene nanosheets was isolated from that for basal planes using Grand Canonical Monte Carlo (GCMC) simulations. The edge sites of such nanosheets show relatively strong Coulombic interactions due to the partial charging at the vertices, while basal planes hardly afford such interactions. The modeling results revealed that the edge sites are more inclined towards CO₂ adsorption, while N₂ mostly sits on the basal planes. This leads to an extremely high selectivity for CO₂ adsorption over N₂ on the edge sites, which the number exceeds 30 in pressures below 0.02 MPa. Therefore, fine-tuning of the edge sites versus basal planes in graphene nanosheets can suit their applications for selective adsorptions, reactions, and separations.
From surface chemistry point of view, basic adsorbents show more affinity towards CO₂ capture due to the slightly acidic nature of CO₂. Consequently, adsorbents modified with amines have shown high CO₂ adsorption uptake, which improves further when nitrogen is effectively incorporated within the support's framework. Thus, researchers have aimed to improve the CO₂ capture characteristics of amine-based carbon materials by increasing the surface density of the amine groups on the support as well as strengthening the amine-support immobilization. Along this approach, polyaniline (PANI), as a rich source of nitrogen-containing groups, has been impregnated on various supports and membranes with promising results. The suitable supports for such applications should meet several criteria including strong attraction for the amine-containing molecules, high surface area with proper pore size distribution, reasonable mechanical strength and hydrothermal stability. Graphene matches very well with the stated requirements, and therefore polyaniline-graphene nanocomposites have shown encouraging CO₂ capture performance.

Successful synthesis of graphene-based mesoporous silica (G-silica) sheets is reported recently with sandwich-like structure and high surface area. Confining graphene nanosheets within individual porous silica sheets enables the end product to have broader applications particularly in ultrafast energy storage. It was found that G-silica sheets can serve as an effective host for immobilizing polyethyleneimine (PEI), as another amine-rich compound (denoted as PEI-G-silica). The resulting PEI-G-silica sheets not only had an ultrathin structure with high PEI surface density, but also exhibited superior thermal conductivities originated from graphene nanosheets. Such features afforded the synthesized nanocomposite for an efficient CO₂ diffusivity/adsorption as well as rapid thermal transfer for faster regeneration kinetics. Accordingly, high CO₂ uptake of 19 wt% with reasonable regenerability at 75°C and atmospheric pressure was achieved by PEI-G-silica sheets.

Graphene-Mn₃O₄ (GMNO) hybrid porous materials have also shown promising carbon dioxide adsorption capacities. Metal oxides that offer various basic sites adsorbents. Obviously, the surface area is another determining factor, and specific strategies are followed to benefit from basicity on higher accessible areas. This includes synthesis of porous metal oxide nanoparticles on high surface area materials.

**Summary**

Alarming carbon dioxide emissions and its detrimental environmental impacts are the major consequences of the undue reliance of the modern civilization on fossil fuels. Long-term solutions to address these issues are based on developing sustainable alternatives for the human energy thirst. However, the versatilities offered by the carbonaceous fuels have still preserved their popularity as the main sources of energy. A substantial development of state-of-the-art materials remains the major bottleneck of such technologies.

**Graphene.** as the rising star of the materials world in 21st century, offers game-changing prospects towards a more sustainable future for fossil-fuel-based economies. This two-dimensional planar sheet of sp²-bonded carbon atoms is the most widely studied nanomaterial since its discovery in 2004. This review aims to throw insights upon various aspects of graphene research in carbon dioxide sensing.

**Bibliography**

After its enormous success in 2001 & 2006, The Textile Association (India) - PHC Unit has successfully hosted 75th Platinum Jubilee All India Textile Conference at Chandigarh on "Indian Textile Industry - A Paradigm Shift" on 15th & 16th November, 2019 at Hotel The Lalit, IT Park, Chandigarh.

At the inaugural session, His Excellency Shri V.P.S. Badnore - Governor of Punjab and U.T. Administrator was the Chief Guest of the function. Shri Ashish Bagrodia - Chairman and Managing Director - Winsome Textile Industries Pvt. Ltd. was the Guest of honor. Shri Satish Marwah, Hon. Secretary, TAI PHC Unit; Shri A. K. Vedhera, Vice President, TAI PHC Unit; Shri S. N. Sodhi, Conference Chairman; Shri L. K. Singh, President, TAI PHC Unit; Shri Hasmukh Patel, Member of Parliament, Lok Sabha, Gujarat; Shri T. K. Sengupta, President, TAI Central, Shri R. K. Vij, Vice President, TAI Central; Dr. Hemant Sonare, Chairman, TAI Central & Shri Prashant Agarwal, Jt. Managing Director, WAZIR Advisors Pvt. Ltd. were present on the dais.

Shri T. K. Sengupta, President TAI - Central Office delivering presidential address

Shri S. N. Sodhi, Conference Chairman briefing about the 75th Platinum Jubilee All India Textile Conference

Chief Guest His Excellence Shri V. P. S. Badnore - Governor of Punjab and U. T. Administrator delivering his inaugural address
At the inaugural session, Shri L. K. Singh, President, TAI, PHC Unit delivered welcome address. Shri T. K. Sengupta, President TAI - Central Office delivered presidential address. Shri S. N. Sodhi, Conference Chairman briefed about the 75th Platinum Jubilee All India Textile Conference. All the present guests on the dais were welcomed by offering floral bouquets.

While addressing welcome address, Shri L. K. Singh, President, TAI PHC Unit emphasizes the importance of positive approach and high altitude in achieving the targets on productivity and quality to make the industry to regain its past glorious golden period.

The Textile Association (India) - PHC Unit felicitated with Industrial Excellence Award to Shri Rajiv Garg - MD, Garg Acrylics Ltd. for his outstanding contribution to Textile Industry and awarded with Rising Entrepreneur Award respectively to Shri Mukesh Tyagi - MD, BST Textile Mills Pvt. Ltd., by hands of Chief Guest His Excellence Shri V. P. S. Badnore - Governor of Punjab and U. T. Administrator.

During the inaugural session The Textile Association (India) felicitated the personalities for the recognition of their Meritorious Services and significant contribution to the Industry and the Association by hands of Guest of Honour Shri Ashish Bagrodia - Chairman and Managing Director -Winsome Textile Industries Pvt. Ltd.. (Dr.) P. G. Patil,has been awarded Honorary F.T.A. for the significant contribution in the academic field. On behalf of Dr. P. G. Patil, Shri Haresh B. Parekh received the award.
Mr. V. C. Zope has been awarded with Service Gold Medal (Instituted in memory of Hon. Maj. R. P. Poddar), for the recognition of his services to the Association. Mr. K. K. Agarwal has been awarded with Service Memento (Instituted by Shri H. A. Shah) and Mr. Rajeshkumar J. Shah has been awarded with Service Memento (Instituted by Shri J. J. Randori), for their services to the Association at Unit level.

Also the Best Unit trophies are awarded with an idea to provide an incentive to the active Unit and to encourage others to be more and more active, contributing to the consolidation of The Textile Associations (India) as a whole. TAI Delhi Unit from the group of larger Units was awarded Best Unit Trophy. There was no nomination received from smaller Unit having less than 1000 member strength.
Shri Hasmukhbhai S. Patel, Member of Parliament, Lok Sabha, Gujarat has been honored and felicitated him with the Memento by Shri Ashish Bagrodia, Guest of Honour. An Attractive Souvenir during the conference was released by Chief Guest and the dignitaries on the dais.

At the end of Inaugural Session Mr. A. K. Vedhera, Vice President, TAI PHC proposed the Vote of Thanks.

Among all the eminent participants some special invitees such as Mr. Aditya Sachan, ED ST Cottex; Mr. T. Chandermohan, Chief Executive, Nahar Spinning Mills; Mr. Mukesh Rustagi, G.M., Nahar Fibers; Mr. K. Kamila, EVP Operations, Sutlej Industries Ltd., Kathua; Mr.U.K.Pattnaik, G.M., Maintenance, Sutlej Industries Ltd., Kathua; Mr. Mukesh Saxena, Corporate General Manager (Technical), Vardhman; Mr.S.L.Garg, Corporate Vice President (Technical), Nahar Industries Enterprises Ltd. (NIEL); Mr.Gurpreet Singh, Sr. Vice President, Vardhman; Mr.VikasMittal, Vice President, Vardhman; Mr. Rajeev Mehani, V.P. (Technical), Vardhman Corporate; Mr. Rajesh Dhingra, Sr. V.P.; Nahar Spinning attended and graced the event.

TAI PHC Unit organized an excellent 2 days conference with appropriate topics, eminent expert speakers and excellent participation from the industry members. All the presentation and the discussion in both Plenary Sessions and the Panel Discussion were of most relevant topics and all were much on innovative, informative and research. There was wonderful hospitality to all participants.

Organizer organized small exhibition of 8 stalls for Allied Textile Products. There were about 26 generous sponsors for this event. On the whole, 75th Platinum Jubilee All India Textile Conference turned out a grand success with over 250 participants gained much from the discussions and deliberations held.

At the end of first day program, Fashion Show was organized, sponsored by Indorama, presented by Students of IIFD, Chandigarh.

Two days conference ended with concluding remark and vote of thanks by Mr. Satish Marwah, Hon. Secretary, TAI PHC Unit.
hand of Shri Prashna B. Shah. Also Shri Prashantbhai B. Shah delivered the speech about the function and encouraged to the students.

Shri Harishbhai C. Shah, Hon. Secretary proposed vote of thanks at the end of the programme.

Glimpses of photographs

Dignitaries on the Dias
L to R: Harish C. Shah, Hon. Secretary; Prashant B. Shah, Guest; Hasmukh S. Patel, President; Ashwin I. Thakkar, Vice President; and Ashok Kumar D. Patel, Chairman

View of Audience

Shri Prashantbhai B. Shah delivering his speech

Shri Harish C. Shah, Hon. Secretary proposing vote of thanks

Align your company with the growing authority in Textiles
Comedy Natak (ALL THE BEST): After immediate of the Diwali get to-gather and prize distribution function, The Textile Association (India) Ahmedabad Unitorganised an entertainment program with comedy natak (All the Best) for the members and their family members. The comedy natak was fully entertaining to the members.

The Textile Association (India) Central Office felicitated to Shri Hasmukhbhai S. Patel, President of TAI-Ahmedabad Unit and Member of Parliament (LokSabha) Ahmedabad-East (Gujarat) during 75th Platinum Jubilee of the All India Textile Conference held on15th Nov, 2019 at Chandigarh. The memento is being handed over by the hand of Guest of Honour, Shri Ashish Bagrodia, Chairman & MD, Winsome Textile Industries Limited.
The Textile Association (India) Central Office awarded Service Memento (Year 2018-19) donated by Shri H. A. Shah to Shri Rajeshkumar J. Shah, Hon. Treasurer, of TAI-Ahmedabad Unit during 75th Platinum Jubilee of the All India Textile Conference held on 15th Nov,2019 at Chandigarh. The memento is being handed over by the hand of Guest of Honour Shri Ashish Bagrodia, Chairman & MD, Winsome Textile Industries Limited.

22nd November, 2019: "Effective English Communication"
The Textile Association (India), Ahmedabad Unit started effective English Communication training workshop for its all office bearers, Managing Committee members and Office Staff.

**View of trainees 1st day of training program at Meeting Room of Dinesh Hall**

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### TAI - Mumbai Unit

**Mr. Vilas V. Gharat Unanimously re-elected as President**

The Textile Association (India) - Mumbai Unit has elected the new Office Bearers for the term 2019-2021. Mr. Vilas V. Gharat has been unanimously re-elected as President of TAI Mumbai Unit.

**Following are the Office Bearers:**

Mr. Vilas Gharat is having Specialization in various field of textile value chain like:

- Change Management, Business Development and Project Management
- Project Management, Business Development
- Supply Chain Management
- Resource Allocation
- Process Reengineering
- Change Management, Production and Business
- Planning Function
- Training and Mentoring CEO's

He has wide experience in:

- Business Consultant for Oswal Hammerle, for their upcoming state of art technology plant for manufacture of sophisticated Yarn Dyed Shirting Project, primarily catering to the needs of international garment manufacturers. This is a Joint Venture project of Oswal group and F.M. Hammerle (Austria)
- His previous assignment involves restructuring and transformation of a large Textile units
- He worked with various executive capacities as Executive Director -Suvin Advisors Pvt Ltd.; Senior President in S Kumar’s., Technical & Commercial Advisor in J. K. Cotton Mills, Senior President in Morarjee Brembana Ltd., Birla’s in Indonesia, Oswal Hammerle, Bhojsons, Nigeria etc.

**Awards:**

Mr. Gharat was awarded with Best General Manager Award in MSTC - National Award for energy conservation for Simplex Mills & MSTC and Best Vendor Award from Johnson & Johnson.

Mr. Gharat was awarded with FTA by The Textile Association (India) in 1999,

**Professional Association:**

He was in Advisory Committee Member for DKTE - Textile & Engineering Institute at Ichalkaranji from 2013 to 2016.

**Professional Training:**

He conducts a various professional trainings of Transformation of Leadership Program, Training in Valle Brembana for High Value Yarn Dyed Shirting. (Italy), Breaking the barrier concept training, Training for Mentoring.
Presently Mr. Gharat is Managing Director: Gharat & Associates (www.gharatandassociates.com), Group Advisors: S Kumars Pvt. Ltd. (www.skumars.co).

Mr. Vilas Gharat is a President of TheTextile Association (India) - Mumbai Unit during 2017-2019 and once again he is unanimously re-elected unopposed & unanimously as a President of The Textile Association (India) - Mumbai Unit for the next term 2019-2021.

Mr. Vikash Gharat has been unanimously elected as Vice President of TAI Mumbai Unit.

Mr. Vikash Sharan has been unhas had a distinguished career in the textile machinery and machine tool industry spanning more than twenty six years in India and abroad. He holds a Diploma in Textile Manufactures from DKTE Society’s Textile & Engineering Institute, Ichalkaranji, Bachelor's Degree in Textile Technology from Victoria Jubilee Technical Institute (VJTI), Mumbai, along with a Post Graduate Diploma in Business Management (PGDBM) from Narsee Monjee Institute of Management Studies (NMIMS), Mumbai. Mr. Sharan started his career as a Service Engineer with the Textile Machinery Division of Voltas, representing spinning machinery from Lakshmi Machine Works, and thereafter, worked his way up the sales ladder, becoming the Branch Head at Mumbai. During the year 2002,

Mr. Sharan was transferred from Textile Machinery Division of Voltas to its International Operations Business Group in Dubai to handle machine tool business for the next six years. He returned to India during 2008 and joined the A.T.E. Group as Vice President, handling the businesses of Nonwovens, Carpets, Synthetics and Circular Knitting. During this time, he was also given the overall responsibility of Bangladesh operations of A.T.E.

Mr. Sharan joined the Saurer Group during July 2017, as Director-Business Development and assumed overall responsibility of Saurer India on 1st March 2018, as Director-India Operations, which include the manufacturing plant at Vadodara, along with functions of Sales and Service, R&D, Product Management and other shared services of the company.

He is a sitting Member of the Board of Saurer India as Whole Time Director. The other facets of Mr. Sharan include a keen interest in sports, music, travelling and photography.

Other Office Bearers as under:

Mr. C. Bose
President Emeritus

Mr. V. C. Gupte
Chairman

Dr. G. S. Nadiger
Vice Chairman

Mr. Rajeev Ranjan
Vice Chairman

Mr. A. V. Mantri
Hon. Secretary

Mr. R. R. Mehta
Jt. Hon. Secretary

Mr. Arun K. Narkar
Jt. Hon. Secretary

Mr. M. B. Nambiar
Hon. Treasurer
The Textile Association (India) Marathwada Unit, Nanded organized jointly with Department of Textile Technology of SGGSIE&T, Nanded a meeting with Power Loom owners on 21st December, 2019.

It was attended by 36 entrepreneurs from Basmath & Nanded. They are engaged in manufacturing of handkerchief (Dasti), Safron (Patka) etc.

Following Power Loom Industry problems were discussed and remedy was suggested by the panel.

1. MSEB office is not cooperating for offering concessional tariff.
2. State textile policy schemes are not reaching to stakeholders.
3. Entrepreneurs are not comfortable with online process.
4. Weaving capacity remain unused in non-season period. They need orders from major textile centers like Bhiwandi, Malegaon, Ichalkaranji etc.
5. Unable to produce quality products due to old technology.
6. Satisfied with traditional products like handkerchief, turban etc.
7. Unable to get membership in textile parks.
8. New generation is not willing to take up the business.

A professional link was established between working People, Entrepreneurs and Industry. The program was arranged in association with Department of Textile Technology, SGGS Institute of Engineering & Technology, Vishnupuri, Nanded. Dr. P.G. Solankar & Dr. R. N. Joshi Honorable Secretory, TAIMU coordinated the program.

THE TEXTILE ASSOCIATION (INDIA)
Central Office

We have temporarily shifted to
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November - December 2019
TAI Marathwada Unit organized Textile Industry Institute Meet

The Textile Association (India) Marathwada Unit (TAIMU) and Department of Textile Technology of SGGSIET & T Nanded jointly organised Textile Industry Institute Meet (TIIM2019) on December 21, 2019 at SGGSIE & T Nanded.

The main theme was ‘Textile Industry in Marathwada Region- Overview, issues and solutions and Interaction of industry professionals, entrepreneurs and students. The participants were 30 top professionals of textile industries from RIL Hazira and Silvassa; Sanathan Textiles; Beekaylon Synt Pvt. Ltd.; Jacob Muller; Filatex Industries; RIICON, Surat; Indorama, Nagpur; PBM Polytex and 35 local textile entrepreneurs and 90 students of Department of Textile technology.

The dignitaries on the Dias were President of Function- Dr. Y. V. Joshi (Director, SGGS), Chief Guest- Dr. Hemant Sonare (Past Chairman , TAI), Mr. Arvind Pahurkar (President TAIMU & MD Simplex), Mr. Umesh Aundhekar (Chairman TAIMU, Director Raipdue Tech), Dr. R. N. Joshi (Secretary TAIMU, Coordinator) Dr. P. G. Solankar (Treasurer TAIMU) and Dr. A. K. Chakraborty (HOD).

On this occasion, the student chapter of TAI Marathwada Unit and Alumni Directory 1991-2019 were inaugurated by Mr. Umesh Aundhekar and Mr. Arvind Pahurkar. Dr. Y. V. Joshi (Director) has appealed to Alumni to interact and connect one to one with the students for career building. Dr. Hemant Sonare has given the ‘Road Map for Textile Industry in Marathwada Region’ and promised to extend the cooperation for setting up Textile Industry. Dr. R. N. Joshi announced that TAIMU will become the Information Centre for Textile Policies, schemes for micro and small entrepreneurs.

The local entrepreneurs have raised the major issues for growth of Textile Industry are lack of sizing and processing facilities, old technology, high labor cost, lack of Information about government schemes and policies. The panel members Mr. Prakash Kadtan, Mr. Arvind Pahurkar, Mr. Kshitij Deshpande, Dr. Hemant Sonare, and Dr. P. G. Solankar have concluded the solutions like bulk purchase of raw material, support & help for processing of cloth in Bhiwandi, centralised marketing, product optimisation, Technology upgradation, TAIMUs role as an Information centre, start-up of plug & play Industry like garmenting, knitting.

Mr. Chetan Chopkar, Mr. Anirudh Mardikar, Mr. Shailesh Deshpande, Mr. Milind Palmwar, Mr. Gokul Pawar have interacted with the students on different topics like career building, Entrepreneurship Opportunities in Textiles, overseas Opportunities.

Dr. R. N. Joshi was Coordinator for this event. TEQIPIII and TAIMU have supported financially to this event. Dr. R. N. Joshi, was the Coordinator for TIIM2019.
Domotex, the world’s largest trade fair for floor coverings, will take place in Hanover from 10 to 13 January 2020. Saurer Twisting Solutions is looking forward to welcoming customers and visitors at their Booth B35 in Hall 11.

**Automation solutions made to measure for processing BCF yarns**

At Domotex, Saurer Twisting Solutions will present customer-optimised solutions for process automation and product cost reduction. Automation of the material transport systems offers significant customer benefits. This is because these systems are individually adapted to the needs of our clients and enable an optimum material flow throughout the entire twisting mill. Whether in the form of a lifter in combination with our rail transport system Flex Flow or the automated guided vehicle Pack Drive, the modern automation solutions offered by Saurer are the next step into the future.

**Easier and faster with new machine generation**

The new generation of our carpet yarn machine, our Carpet Cabler Carpet Twister 1.10, offers an optimum of possibilities for reliably and confidently mastering even the most unusual requirements of a lively market.

Central adjustments of almost all production parameters, an intuitive user interface and the newly designed take-up area significantly reduce the machine's changeover times. Modern drive technology and innovative yarn sensor technology for monitoring the yarn quality generate significant added value for our customers.

**Process control with Saurer Mill Management System Senses**

This digital system bundles and analyses production, quality and performance data across all divisions. Even machines from third-party manufacturers can be managed. Plan deviations, quality fluctuations or irregularities are thus detected in real time, enabling mill managers to react quickly. They can also use the sum of the data to analyse processes comprehensively in order to find opportunities for optimisation.

The Saurer exhibition team is looking forward to welcoming customers and visitors at the Domotex 2020 and to informing them about the latest developments.

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Birla Cellulose, (www.birlacellulose.com) of USD 44.3 Billion Aditya Birla Group, one of the global leaders in man-made cellulosic fibre (MMCF), has emerged as the top company for eliminating endangered forests from its supply chain in the environmental non-profit Canopy's 2019 Hot Button Ranking and Report.

"The Aditya Birla Group firmly believes and advocates against the concept of undertaking half-hearted efforts and the same is reflective through the quality of work that it undertakes. It is because of this firm belief of ours that we have been successful in achieving a great ranking in Canopy's Hot Button Ranking and Report for the third consecutive time and we solemnly pledge to strive towards achieving and establishing higher benchmarks in the years to come," Dilip Gaur, Business Director - Global Pulp &Fibre Business and Managing Director - Grasim Industries Ltd., a flagship company of Aditya Birla Group.

Canopy's Hot Button Report evaluates the global producers of viscose and ranks them on the sustainability aspects of their raw material sourcing practices. The criteria of ranking include protection of ancient and endangered forests, innovations in alternate raw material developments and supporting global forest conservation solutions. The viscose producers are inspected and awarded 'green buttons' based on parameters such as completion of CanopyStyle audits, contributions to forest conservation, using new alternative fibres, wood sourcing that promotes sustainable forestry, social accountability related to forestry, transparency and traceability.

It is heartening to see the broad impact of Canopy's initiatives that more than 200+ brands, retailers and designers have committed towards protection of ancient and endangered forests and sustainable forestry by working on their sourcing policy of viscose preference to viscose producers with higher ranks in the Hot Button report. This is positive development and would lead to sustainable forestry practices by the textile industry, protection of forests and its net positive growth play an important role in mitigating climate change impacts. Viscose comes from the nature and goes back to the nature as it is fully bio-degradable, produced using closed loop manufacturing it is among the most sustainable choice of fibre for textile applications.

Birla Cellulose has developed innovative technologies to recycle pre-consumer wastes that has immensely benefited actively taken part in the movement of using alternate means of raw material for the generation of its products and has been immensely beneficial in successfully catapulting the company to the highest spot in the market.

Birla Cellulose utilizes an extremely efficient product traceability system which makes it possible to trace the source of fibre across its value chain, this can help consumer select a more sustainable fabric.

Leadership in Canopy's 2020 Hot Button Ranking is another testimonial of our goal to be a leader in the Sustainable Business Practices and it is the endeavour to continue our work in this direction.

Link to The Hot Button Report: https://hotbutton.canopyplanet.org/company/aditya-birla/

For further details visit www.adityabirla.com and www.birlacellulose.com

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**China Home life and Machinex India 2019**

India's leading Expo on premium Chinese products, 7th edition China Homelife and Machinex India 2019 launched in Mumbai.

- More than 1500 exhibitors from China, displaying over 25,000 products.
- Conferences, Presentations and panel discussions to discuss and deliberate on wide ranging industry topics
- Confederation of Indian Industry (CII) is the National Partner for this exhibition and will be organizing China-India Economic Forum

China Homelife/ Machinex', the much awaited three
Day (11th-13th December 2019) trade show organized by Meorient International - Shanghai, commenced at the Bombay Convention and Exhibition Centre, Mumbai.

Day One of the trade show was inaugurated by Shri. Sunil Rane, MLA - Government of Maharashtra; Mr. Sunil Khanna, Past Chairman, Maharashtra State Council & President and MD, Vertiv India.; Ms. Jane Karkada, Regional Director - Western Region, CII; Mr. Ashish Vaid, President IMC Chamber of Commerce & Industry.; Mr. Siddharth Shenoy, President, Bombay Industries Association; Mr. Xu Qinshan - Deputy Secretary General of Hangzhou Municipal People's Government; Ms Liu Xiaohong - Investigator from Bureau of Commerce of Anhui Province.; Mr. LuoLinfeng - Deputy Head of Xiaoshan District of Hangzhou Municipal People's Government; Mr. XuLijun - Section chief from Wenzhou Bureau of Commerce; Mr. Tang Guocai, Consul General, Consulate General of the People's Republic of China, Mumbai; Mr. Eric Pan CEO, Meorient.

China Homelife India, in its bigger avatar, will represent products like: Furniture, Textile & Garments, Home Appliances, Household Items, Gift Articles, Luggage Bags and many more; whereas, China Machinex India will show: Building Materials, Hardware and Tools, Lighting, Auto Parts, Machinery and various other sectors. The twin exhibitions will witness a tremendous response from the industry with participation of more than 1500 exhibitors from China, displaying over 25,000 products spread over 3 halls spanning over 38000 sq. mtrs of the exhibition area.

Confederation of Indian Industry (CII) as the national partner for this exhibition, will be organizing China-India Economic Forum on 11th December 2019 concurrent to China Homelife India & China Machinex India 2019, which will see participation from the Captains of the Indian Industry.

The objectives of this forum are deepening bilateral relations, enhancing the economic engagement and exploring various trade opportunities between India and China. In addition, the expo will hold 3 mini Conferences which will include series of presentations on specialized industry topics were India-China Textile Cooperation; India-China Machinery Cooperation; India-China Electronics Cooperation.

CHINA HOMELIFE AND CHINA MACHINEX INDIA 2019 continues to focus on the increasing trade and building sustainable relationships between Chinese and Indian companies to congregate and conduct business. Spread over three days, CHINA HOMELIFE AND CHINA MACHINEX INDIA 2019 will witness several exciting partnerships and announcements that promise to augur in new trends in the industry.

Mr. Eric Pan, Chairman, Meorient said "We are delighted to be the organisers of India's largest event showcasing Chinese trade, which would lay the foundation to choose the latest technologies for our future needs. China Homelife/ Machinex' provides companies with the exposure to meet industry stakeholders, industries experts, who can present innovative technologies that can help grow trade between the neighbouring countries. Apart from providing a platform to showcase their products and innovations, the Trade Fair also presents the opportunity for participants to network with potential business experts."

Mr. Binu Pillai, COO, Meorient said, "We marvel at the way China Homelife and China Machinex India, has grown to be the most influential event in the corporate landscape, with the Indian business community throwing open its doors to Chinese trade. We have also provided a platform for an Indian business delegation to meet with Chinese Government officials. We look forward to the 7th edition of the Trade Fair breaking new grounds, with three days of high intensity business deliberations."

The Trade Fair was well received by the industry at large with support from Associations in FMCG and Core Industry such as Association Of Furniture Manufacturers & Traders (AFMT); Bombay Industries Association (BIA); Indian Chamber of International Business (ICIB); Indian Merchants' Chamber (IMC); Global Textile Welfare Association (GTWA); India Tech Foundation (ITF); Jamnagar Chamber of Commerce India (JCCI); Luminaires Accessories Components Manufacturers Association (LACMA); Marathwada...
Chinese super farms may boost sales of agri-drones tremendously

China’s largest agricultural drone maker expects to double its sales next year as the government pushes for the creation of bigger farms that will require more of the technology.

XAG forecasts domestic sales volumes to rise to 50,000 drones in 2020 from about 25,000 this year. The drones are used for seeding, fertilising and spraying pesticides. More farmers are transforming their small plot of land into large farms. That makes drones more popular.

China’s political leaders are encouraging smaller farmers, which make up the majority of the rural landscape, to consolidate and become part of large-sized collective farms in a bid to improve efficiency in food production. The shift follows some 288 million farmers who have moved to cities to seek better paying jobs, leading to several empty villages.

One area of China’s rural land reform is to allow families to rent out their contracted land to large companies or cooperatives for large-scale operations. By the end of 2018, more than one-third of contracted land handed over to bigger operations. One area of China’s rural land reform is to allow families to rent out their contracted land to large companies or cooperatives for large-scale operations.

Chinese super farms may boost sales of agri-drones tremendously

We've seen a big decrease in the rural population, especially as the younger generation are leaving the countryside for cities. We have to find a solution for farmers to produce better food for our urbanization demand.

XAG is also launching a self-driving utility vehicle, which is about 20% cheaper than drones, and aims to expand its business to villages where small household farmers can easily learn to use the vehicles.

The ground vehicle can be used in fruit gardens and crop fields in the north of the country where land is flatter.

Chinese government subsidies for farmers purchasing the company's products should also boost XAG's sales. Subsidies cover about one-third of the cost of the drones and vehicles.
Facilitating Trade & Cementing Friendships at India ITME Society's 40th Year Celebration

Three Day programme from 19th, 20th & 21st December 2019, commencing with B2B meetings for exclusive delegation of women entrepreneurs from 4 African Nations looking at sourcing from India, kick started the Celebrations for India ITME Society. This B2B event was attended by 52 Indian Companies with 462 meetings during the day including interaction with Indian Institutes & Associations resulting in business & MOUs for student faculty exchange programme and also a promise for out bound delegation from India to Uganda. International Trade Centre (ITC), organized this 1st time initiative of bringing an all women delegation to India in Partnership with India ITME Society. For the Society, completing its 40th Year of service, this activity was a step towards supporting women empowerment by encouraging entrepreneurship in Textile Sector.

Apart from Business, this 1st time overseas delegation were also treated to a special Heritage walk of GPO organised& initiated by Ms. Swati Pandey, Postmaster General, Govt. of India.

Among the activities offered to the betterment of the industry & for enhancing the quality of Education in Textile Engineering, a special Technical session was organized by India ITME Society. The technical presentation on “Digitization and sustainability - Two drivers for the textile industry” by Dr.-Ing. Yves-Simon Gloy, Adjunct professor in Clemson University & RWTH Aachen Institute of Textile Technology, Germany was well received by the academic community, attended by 180+ faculty & students from various Institutes like, VJTI, ICT, DKTE, SNDT, NIFT, Kushal Institute, Bangladesh Textile Institute etc. Dr. Prof. Josphat Igdawa Mwasigi, MOI University, Kenya, alumni of PSG College of Engineering, Coimbatore also made presentation & discussed collaboration with Institutes paving way for new partnership in sharing knowledge between India & Kenya. This also shall create avenue for students to explore placement opportunities with multinational companies functioning in Africa.

India ITME Society is not only about Textile & Textile Engineering, but functions as a culturally conscious organization promoting all aspect of India as a traditionally rich nation. To showcase rich textile heritage encaptured in our Postal stamps, India ITME Society organized philately exhibition for the invited guests from pan India & across the globe. Ms. Swati Pandey, Postmaster General, (Mumbai Region), Govt. of India, made a scintillating presentation on “History of Indian Postal Service”, educating audience about the services rendered by the Indian Postal Department even in the toughest of the tough conditions & how India Post plays a part not only in our heritage but also in our day to day lives even in today's digital times.
Every invited guest, whether from India or overseas had a take away from India ITME Society’s 40th year programme. The various Textile & Textile Engineering Associations renewed their collaboration with India ITME Society through MOUs & also shared their experiences, suggestions & way forward to improve trade relations with their respective countries &organisations in a highly interactive Global Connect session in the afternoon session. The panel of speakers consisted of Industry leaders from India & across the globe.

L to R: Mr. Ketan Sanghvi, Hon. Treasurer, India ITME Society, Mrs. Doris N. Kessie, Textiles And Leather Of Association Of Ghana Industries (AGI), Mr. Faruque Hassan, Hon. Consulate of Greece in Bangladesh & Past Senior Vice President, BGMEA, Mr. Richard Salvatore MBE, General Coordinator, TEMSAD, H.E. Mr. Demeke Atnafu Ambulo, Consul General, Consulate General of the FDR of Ethiopia, Mr. S. Hari Shankar, Chairman India ITME Society, Mr. Krishna Chinniah, President Botswana Textile Clothing Association (BTCA), Mr. Govind Venuprasad and Country Manager for India, ITC.

H.E. Ms. Dorothy Tembo Deputy Executive Director, International Trade Centre, UN, spoke about importance of Strengthening Bilateral Trade Relation with Neighbouring Countries.

A Stamp commemorating 4 decades of "Spearheading Innovation with Commitment to Quality" was released by Ms. Swati Pandey in presence of Shri. P. Sathasivam, Former Chief Justice of India & Former Governor of Kerala (Chief Guest) & H.E. Ms. Dorothy Tembo, Deputy Executive Director, International Trade Centre (Guest of Honour)

India ITME Society extended the mood of celebration for both young & old, across the social & business segments. Certificate of merit & a cash prize of 1500 USD (1 Lakh INR) were awarded to the winners of the contests organized by India ITME Society in various categories.
Outstanding Contribution to Industry Growth & Social Impact By An Association - Bhagamunda TRCS Ltd.

Best Digital Adoption By An Industry Association - Jodhpur Handicrafts Exporters

Women Empowerment through Entrepreneurship - Ms. Kuni Dehuri

Women Leadership Textile Engineering Sector - Ms. Khushi Palkhiwala

India ITME Society acknowledged the contributions & expressed gratitude to the Stalwarts of the Industry who mentored growth of India ITME Society over the last 4 decades.

Technical Know How for Textile Engineering Industry - Ms. Trupti Khedekar

Shri. Narendra Shah, Past Chairman

Shri. G.T. Dembla, Past Chairman
The evening brought together people from different walks of life, countries and culture, in knowledge, in business, in comradeship concluding the celebrations with live musical performance “Pristine Harmonies.”

Ms Seema Srivastava, Executive Director, India ITME Society said that the road ahead shall be as challenging, as unpredictable, but India ITME Society shall continue to pursue and strengthen its capabilities to lead the Textile Industry & Textile Engineering to further heights through its ambitious and unique initiatives. Humility of Action, Integrity of Purpose and transparency of Conduct will be the key traits driving India ITME Society’s growth and journey forward.

A good father is one of the most unsung yet one of the most valuable assets in our society. Every father tries to leave a lasting mark on his children. Legacy isn’t confined to a will or an inheritance, it is what a father gives them in terms of support, wisdom, character, and faith. And when it comes to handing over business, every father nurtures his children with his best knowledge and acumen.

Bhilwara province, Rajasthan, India, has witnessed three such prime examples of highly successful fathers passing on their trade secrets to their sons. Nitin Spinners, Sudiva Spinners and Lagnam Spintex, all highly renowned spinning mills were formed by fathers and are now looked after by their sons. In all three ventures, one thing which is common is - brand Trützschler.

The creative approach to supercharge your brand
Visionary leader and Chairman Mr. R. L. Nolkha is a professional with an experience of five decades and worked with prominent groups like BSL and RSWM. He was also the CEO of LNJ Bhilwara group for more than two decades. He founded Nitin Spinners in 1992 as a launch pad for Mr. Dinesh Nolkha, who had just completed his Chartered Accountancy. Starting with a humble beginning of two open ends, today Nitin Spinners stands tall with an enormous capacity of 3 lakh ring spindles, 3500 rotors, 63 knitting machines, 168 air-jet looms with 200 tonnes per day production of 5s to 80s yarn counts. In 2002, the second son Mr.NitinNolkha who is a Management Graduate also joined the board as an Executive Director. With more than 19 Years of Industrial experience, Mr.NitinNolkha looks after procurement of materials and implementation of projects.

Mr. R.L. Nolkha happily remarked that "We are high quality manufacturer of yarn and do not believe in compromising quality on any parameter". We needed "the best possible technology partner and Truetzschler perfectly fitted the bill."

The relationship which started in 1997 with the purchase of DK 740 cards continues with TC 10 cards in our latest project. At present Nitin Spinners have 142 Truetzschler cards in all their units. Mr. Dinesh Nolkhasaid that "Since Truetzschler is the preferred supplier for many reputed spinning mills, they should further enhance their core strength and continue to excel in their product domain and offer end to end solutions in Sliver Preparation".

Nitin Spinners which recently forayed into Blends opted for the T blend from Truetzschler. Mr. Dinesh Nolkha praised the Blending technology of Truetzschler. He said "It gives us more flexibility to produce different blends with the highest precision and lowest CV%." By combining a sharp focus on sustainable profitability with innovative products, the father-son trio have created a name for Nitin Spinners in more than 60 countries covering five continents where their yarn is exported.

Elsewhere one of the doyens of the Indian textile industry Mr. J. C. Laddha, had similar plans for his son. Mr. J. C. Laddha has a vast experience in the textile industry from 1973 having worked with the RSWM group in the highest capacity. He already knew the advantages of Truetzschler machines as he was instrumental in setting up / modernising the various units of RSWM during his long stint at RSWM. When in 2006 Mr.VarunLaddha returned from USA, after completing his higher studies, he had a choice of joining a company or starting his own company. Fuelled by his extra-ordinary commercial knowledge and technical experience, Mr. J. C. Laddha guided him in setting up his first venture- Sudiva Spinners.

Mr. Varun, now a first-generation entrepreneur explained "Out of ring spinning and open end, I opted for OE process as my first project because it required relatively lesser capital investment. However to get the best quality yarn with highest productivity, we opted..."
for the best in class machinery from Truetzschler”.

At present Sudiva Spinners has about 74,000 spindles and 2208 rotors producing counts ranging from 6sNe to 40sNe having per day yarn production of 80Tons and 8Tons of knitted fabric. The latest project which was commissioned in 2018 was one of the first spinning Unit in India to opt for the latest “TC15 Cards with T Move and Jumbo cans”. Today, the unit hosts 59 Truetzschler cards commissioned in 3 different phases. By focusing on product development and taking calculated risks, Mr. Varun has ensured that Sudiva Spinners not only dominates the domestic yarn market but is an impeccable supplier of yarn to more than 32 countries around the globe.

The charismatic and tech savvy Mr. D.P.Mangal was the Executive Director of Rajasthan Spinning and has an experience of more than 40 years in the textile industry. He along with his son, Mr. Anand Mangal founded Lagnam Spintex in 2011 with four open end machines having 1920 Rotors fed by Truetzschler preparatory machines. Mr. Anand Mangal completed BSC (Honors) in Business & Management Studies from University of Bradford, UK. He has also worked with ICICI Bank from June-2006 to Mar-2011. Since 2011 he is working as Managing Director of the company responsible for production, marketing, purchase and administration of the existing textile facilities. From the beginning Mr. D.P.Mangal was very clear to have the latest technology machines in his plant. So, it was no surprise that when they went ahead for expansion plan for 25,536 spindle plant in 2018, they opted for the latest TC 10 cards with the T-Move and Jumbo Cans. According to Mr. Mangal, Truetzschler’s innovative T-Move and Jumbo Can Concept has provided them with greater benefits and improved process efficiencies, against a standard coiler solution. Presently, Lagnam Spintex has production capacity of 35 tonnes per day, out of which an astounding 50% goes for export with the yarn count ranging from 6 Ne to 30 Ne.

In a very shortspan, by harnessing the opportunities, Lagnam Spintex emerged as a manufacturer of quality yarn for both domestic as well as export market. Lagnam Spintex is one of the few spinning mills in the world to be certified by Uster, for producing top-quality open-end yarn. Lagnam prides itself in producing yarn of highest quality with Productivity & safety at all levels.

When asked about the current scenario of the textile industry both Mr. R. L. Nolkha and Mr. D. P. Mangal showed their concern over the disparity in domestic and imported cotton prices caused due to the MSP. Mr. Varun Laddha on the other hand, voiced his concern over different states offering different power tariffs, which gives lower margins for manufacturers in states, which have dearer power supply. He demanded a One Country One Tariff regime.

When asked about A.T.E., Mr. Dinesh Nolkha remarked that over the last decade A.T.E. has grown as a company by bringing the most advanced and required technology to the Indian market. Mr. J. C. Laddha echoed his thoughts and said that A.T.E. understands the needs of the Indian customers and provides the right solution through principals like Truetzschler.

Looking at the trust bestowed by the esteemed customers it is fair enough to say that “It’s True! It’s Truetzschler.”

India China Textile Co-operation Forum

India’s leading Expo on premium Chinese products, 7th edition China Homelife and Machinex India 2019 launched in Mumbai.

During the exhibition, India China Textile Co-operation Forum was organized on 11th December 2019 at Matchmaking Lounge of Hall No. 1 at Bombay Exhibition Center, Goregaon, Mumbai.

The Forum began with Mr. Arvind Sinha, President Global Textile Welfare Association and Past President of The Textile Association (India), who set the tone with his speech made a presentation on Indo-China Textile Business - A Review and talking about merits of collaborative approach between India and China. He also mentioned China has come up with a big way as far as textile and apparel industry is concerned.

Taking largest pie of the industry on total trade and the growth phenomenon, which has happened in past three decades. Gradually they have increased their stake and reached to this stage.
During his presentation he mentioned many examples of Indo-China mutual co-operation and also expressed Strength China has and the areas where Indo-China Relationship can benefit each other. China has huge manufacturing capacities while India has large trained manpower and also established labour laws, a very established legal systems, large population base etc.

Indo-China has lot of similarities and therefore India needs co-operation with China in Technical Textiles, Textiles for Agriculture, Automobile Industry, Transportation Industry, and Defense where development can take place for mutual benefits for both the countries. Both the countries are controlling approximately 50% textiles world trade. Taking largest pie of the industry on total trade and the growth phenomenon, which has happened in past three decades. Gradually they have increased their stake and reached to this stage.

Mr. Avinash Mayekar, MD & CEO of M/s Suvin Advisors Pvt. Ltd, while speaking on his topic ‘Possibilities of joint collaborations, importers of Textile Machines, Dyes Stuffs and Fabric from China’ said that we Indians have to accept China as a "big brother."

He also stressed on the point that there is no culture of dedication and commitments towards work in Indian Textile industry hence we lack in efficiencies. We need to have collaborative approach in between two countries to achieve common goals. He stressed upon further stating that India has it’s large strength of processing cotton based products in the international market hence India can supply cotton based technical textiles, hand loom products, grey fabrics to China. Similarly, China can supply high quality garments back to India.

China also excels in digital printing & machinery manufacturing as well as creating huge scale of economy and appropriate large size infrastructure. There can be arrangements of such bilateral trade in between the two countries. As far as machinery sale is concerned, both the countries have good scope for various machines for e.g. China is very strong in sewing, embroidery, digital printing & weaving machines along with some wet processing machines whereas India is strong in spinning machines and some processing machines.

Mr. Mayekar also said that both countries should understand their strengths and weaknesses and accept whatever is required to benefit both countries. Mr. Manish Daga who owns brand Cotton Guru informed about the importance of cultivation of clean cotton, what things needs to be done and how India is progressing in this particular field and both the countries have opportunity to close on the entire world.

The panel discussion on the topic ‘Importance of Indo-China Textile Co-operations’ includes panelist like Mr. Avinash Mayekar, MD & CEO Suvin Advisors; Mr. Subhash Bhargav, Chairman & Managing Director Colorant; Mr. Manish Daga, Managing Director, Cotton Group and Dr. Hemant Sonare, Group Director for Wanjari Group of Institutes along with Mr. Arvind Sinha as the moderator.

On India China Cooperation possibilities According to Mr. Manish Daga, China is exporting thousands of items to world & India whereas India exports very few items to China.

Being similar climatic conditions & crops to grow are also similar, but China has capitalized on the economics of strain and also on research, development and value addition. India needs to learn this from China. India has benefit of availability of raw material, skill sets and low labour cost. India & China should join hands together with their strengths.
Mr. Subhash Bhargav said that India & China altogether is having 1/3rd of world's population. China's economy development is in two digit for last so many years whereas India's economy is developing with single digit.

Also chemical market is progressive in India and Indians are very good in having quality of effluent treatment plant manufactured, control and disposal of dyes and chemicals. He further added China as well as India are facing social and environmental issues and hence both countries can come together to sort the issues.

Dr. Hemant Sonare was impressed that discussion was on cooperation instead of comparison between India & China. India has strength of cotton based products and complete value addition can be done in India. He further added if Quality from India & Quantity form China collaborates, these two countries will be driver of world economy. Mr. Sinha told that the China is having huge manufacturing capacities which are running at 45% - 50% only. If utilization increases by 7% - 10%, half of world production will stop.

CONCLUSION:

The session was concluded by giving momento's to all speakers and panelists as a token of appreciation.

Mr. Arvind Sinha moderator of the panel concluded that there is a huge scope between India and China for mutual co-operation, already trade is going between both the countries and this can multiply many folds. Textile is everyday opportunity, innovations are everyday and therefore India and China has to share their strengths for the benefit of each other.
India always recognized China as big brother and therefore there is no reason why we should not come together for mutual co-operation and go for technology transfer and improve manufacturing base, there is huge opportunity for Chinese Machine Manufacturers to come to India and sell machines, there is a big scope for establishing large fabric process houses. Any improvement in the technology is very well acceptable in India and for any differences both the countries must come and discuss to resolve. There is lightly big scope for both the countries and they could decide how to proceed faster?

**Texttreasure**

The proper use of science is not to conquer nature but to live in it

- Barry Commoner
Integrated quality assurance for nonwovens

USTER® in-process inspection for tightly-spaced production lines

Fabric manufacturers serving critical applications need quality that is both precise and secured. But in the typical nonwovens process line, space is always at a premium, making it tough to fit suitable automated inspection systems which deliver these requirements effectively. The USTER® EVS FABRIQ VISION N inspection technology solves the problem, with customized solutions designed to slot neatly into tightly-spaced production units - at the same time ensuring light conditions allow the best detection results and reliable data for optimal first quality yield.

USTER offers quality solutions suited to nonwovens premium segments. In textile applications from fiber to fabric, USTER expertise is already appreciated worldwide. Now the nonwovens community is recognizing what has been acknowledged in the spinning industry for more than 70 years. Expert knowledge in yarn quality - including controlling all kinds of contamination - is now extended to fabric and nonwovens quality assurance. This is based on the know-how of EVS, a world-leading high-technology supplier of automated vision inspection, acquired by USTER in 2018.

USTER® EVS FABRIQ VISION N fabric inspection now represents a second solution for nonwovens - along with USTER® JOSI fiber cleaning systems - supporting the unique ‘Think Quality’ approach of USTER.

Automated in-process control

Consistently high rates of defect detection, to guarantee reliable quality, are required by fleece manufacturers. USTER® EVS FABRIQ VISION N ensures this, by using automated control during intermediate inspection. USTER® EVS FABRIQ VISION N locates any visible faults objectively and consistently. Defects in every roll are located and recorded, at normal line running speeds.

USTER® EVS FABRIQ VISION N stands for seamless integration of an inspection system into any production process - and ideally into nonwovens manufacturing lines - detecting holes, irregularities, contamination and any other defect. The installation is easy and flexible: a fixture bar bridges the full width of the process line holding as many spectroscopes as required for the application. The sophisticated spectroscopes offer best monitoring conditions for the inspection. To guarantee optimal defect detection in combination with the spectroscopes, various light sources are integrated in the installation - all customized and perfectly suited to mill light conditions.

The system may be slim and compact, but it delivers big-value benefits for the operator. USTER® EVS FABRIQ VISION N provides real-time alerts, showing all defects and automatically creating roll inspection charts. All detected faults are collected in an album review. Here, the operator can quickly mark faults and select which can be deleted. Users can set their own quality standards for different types of nonwovens, increasing the efficiency of the grading process - and finally delight the customers with consistent quality.

Optimized yield for manufacturers

"USTER® EVS FABRIQ VISION N offers manufacturers significantly improved first-quality yield, for all applications," says John Belew, USTER Vice-President for fabric inspection. The combination of a full map of fabric defects and the cut optimization module means more first-quality rolls can be produced and bad quality taken out.

USTER® EVS FABRIQ VISION N leads to total fabric quality assurance, and major advantages for production security and profitability. "Our customers aim for confidence in delivering the right quality to strengthen customer relationships. With USTER® fabric inspection systems, they can guarantee quality compliance and protect their business," says Belew.

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International Business News
US-China trade deal possible before end of year: White House adviser
A senior adviser to President Donald Trump said on Monday that a US-China trade deal was still possible before the end of the year, adding that the first phase of the agreement was being put to paper, reported Reuters.
"Sure." White House adviser Kellyanne Conway told reporters when asked if a deal were still possible this year to address some trade disputes between the world's two largest economies.
US President Donald Trump on Monday said US legislation backing protesters in Hong Kong did not make trade negotiations with China easier, but added he believes Beijing still wants a deal with the United States.

Manufacturing activity expands at fastest pace in almost three years: Caixin survey
The rate at which China's manufacturing activity is growing rose to its highest point in nearly three years in November, driven by rising stocks of purchased items and stronger job creation, a Caixin-sponsored survey showed Monday.
The Caixin China General Manufacturing Purchasing Managers' Index (PMI), which gives an independent snapshot of the manufacturing sector's operating conditions, rose further to 51.8 in November from 51.7 in the previous month. Though the rate was only marginally higher, it marks the strongest expansion since December 2016.
The Caixin PMI is one of the earliest available monthly indicators of economic conditions in China and is closely watched by investors. A number above 50 indicates expansion, while anything below 50 points to contraction. Manufacturing accounted for nearly 30% of China's gross domestic product in the first nine months of this year, according to data from the National Bureau of Statistics.

Russia launches gas pipeline to China
Russia has begun gas supplies to China via the Power of Siberia pipeline, the largest gas project in its history and a symbol of Moscow's diplomatic pivot towards Beijing at a time of worsening relations with the west, reported the Financial Times.
Dubbed "the contract of the century" by Russian gas group Gazprom, the $55 billion deal with China's oil and gas major CNPC will eventually allow for 38 billion cubic meters in annual gas supplies to China via the 3,000km pipeline that crosses Siberia to the Chinese border in the south-east.
The pipeline will allow Gazprom to significantly increase gas exports amid declining demand and gas prices in its traditional export markets of Europe and Turkey, which buy on average about 200 billion cubic meters of gas a year. Work on the pipeline began shortly after the US and the EU introduced the first Crimea-linked sanctions against Russia.
The two leaders launched the project via video, Russian president Vladimir Putin from Sochi and China's president Xi Jinping from Beijing. "This is truly a historic event, not only for the global energy market, but first of all for us, for Russia and China," Putin said from Sochi. "This step takes Russia-China strategic energy relations to a new quality level and brings us closer to reaching the goal set together with Xi Jinping to raise mutual trade turnover to $200 billion by 2024."

China's Zijin Mining to buy Canada's Continental Gold for $1 billion amid security risk
China's Zijin Mining Group has agreed to buy Canadian miner Continental Gold for C$1.3 billion ($1 billion), but a top executive with the target company said elevated security concerns in Colombia pose a risk to the deal, reported Reuters.
State-backed Zijin's offer for Continental, announced on Monday, aims to secure Continental Gold's flagship Buritica gold project in Colombia.
"Zijin doesn't have any experience in Colombia, and we have obviously had some incidents in the past," Continental Chief Financial Officer Paul Begin told Reuters. "But if a major security incident happened at any project, it would be considered a material adverse change and they would have an out if they wanted to," he said.
Zijin's cash offer of C$5.50 per share represents nearly a 13% premium to Continental's Friday's close.
Continental's shares were up nearly 10% in Monday afternoon trading in Toronto.

CBD oil sold on China's e-commerce platforms raises regulation concerns
Products containing cannabidiol oil, an essential part of marijuana, can be found on China's three major e-commerce marketplaces, even though consumption of marijuana is illegal in the country.
Search results for cannabidiol oil, commonly known as CBD oil, on Alibaba Group's Taobao, JD.com and
Pinduoduo show multiple sellers offering "US-imported" or "authentic imported" cannabidiol oil, claiming their products can help with sleeping, depression, inflammation and even bone growth and cancer-fighting, reported Caixin.

Unlike the US, where the recreational use of cannabis is legal in many states, China strictly bans the use and sale of cannabis, even calling the legalization of marijuana in Canada and parts of the US a "new threat to China," sparking a spike in the amount of drugs smuggled into the country.

Some sellers on the e-commerce platforms know they are operating in a gray area and try to avoid problems by posting disclaimers. One seller on JD.com says in the product description that the cannabis oil is brought into China through overseas channels. Once buyers confirm their orders, no claims can be made regarding labels, origin or inspection reports, or on the ground that foreign products do not comply with China's laws and regulations, the seller says.

**China’s economy set for more pain in 2020 as growth forecast sinks further**

China's economic growth could drop below 6% next year for the first time since 1990 as the world's second-largest economy continues to be affected by the trade war with the US and cooling infrastructure investment, UBS Wealth Management forecasts, reported Caixin.

Real gross domestic product (GDP) is set to increase by just 5.7% in 2020, according to Hu Yifan, regional chief investment officer and chief China economist at UBS Wealth Management, a unit of Switzerland-based banking group UBS AG. That compares with an estimated 6.1% in 2019 and would mark the third straight annual slowdown.

China's GDP growth slipped to 6.6% in 2018 from 6.8% the previous year, and was 6.2% year-on-year in the first nine months of 2019, the National Bureau of Statistics said in October.

Hu isn’t the only analyst forecasting sub-6% GDP growth in 2020. Nomura Holdings Inc., Goldman Sachs Group Inc. and Moody’s Investors’ Service estimate expansion of 5.8%. Morgan Stanley is a little more optimistic, with a base case scenario of 6%, although its economists say growth could slip to 5.9% if the trade war worsens and the property market slumps, and could fall as low as 5.3% in a worst-case scenario where trade talks with the US break down and more tariffs are imposed by Washington on Chinese goods.

US-China trade deal ‘stalled because of Hong Kong legislation’: Axios

Top Chinese bank regulators moved to defuse growing unease in the country’s $40 trillion banking system after two small lenders were hit with bank runs in less than two weeks, reported Caixin.

In a briefing on Tuesday, three senior officials of the China Banking and Insurance Regulatory Commission (CBIRC) pledged to contain liquidity risks among the country's thousands of smaller banks. They addressed incidents involving Yingkou Coastal Bank in northeastern Liaoning province last week and Yichuan Rural Bank in Luoyang, Henan province, in late October.

The regulators attributed the runs to false online rumors and sought to restore confidence on the lenders. The world’s largest banking system has been rattled this year not only by those two incidents but also by earlier crises at three other banks.

"The banking industry is very sensitive," said Liu Rong, vice department chief of city commercial banking at the CBIRC during the briefing in Beijing. "We should improve the mechanism of liquidity risk management for small and medium sized lenders and fend off systemic financial risks."

**China’s factory activity unexpectedly returns to growth in November**

Factory activity in China unexpectedly returned to growth in November for the first time in seven months, as domestic demand picked up on Beijing’s accelerated stimulus measures to steady growth, reported Reuters.

But gains were slight, and export demand remained sluggish. With China's economic growth cooling to near 30-year lows and industrial profits shrinking, speculation is mounting that Beijing needs to roll out stimulus more quickly and more aggressively, even if it risks adding to a pile of debt.

The Purchasing Managers’ Index (PMI) bounced back to 50.2 in November, its highest since March, China's National Bureau of Statistics said on Saturday, above the 50-point mark that separates growth from contraction on a monthly basis.

The result compared with 49.3 in October. A Reuters’ poll showed analysts expected the November PMI to come in at 49.5.

**Chinese vice premier stresses all-out efforts in restoring hog production**

Chinese Vice Premier Hu Chunhua on Saturday underscored restoring hog production and ensuring the steady supply of livestock products by every means,
China must ensure stable pork supply in key periods of early 2020, including the Lunar New Year holidays in January and during the annual National People's Congress in March, Xinhua cited Hu as saying at a meeting on animal husbandry on Saturday.

Millions of pigs have died or been culled due to the African swine fever outbreak in China and other Asian countries such as Vietnam. The disease has slashed China's pig herd by as much as half since August 2018, US agribusiness firm Archer Daniels Midland Co said in November.

The ravaging of pig herds in the world's top pork market helped to drive China's consumer price index (CPI) up 3.8% year-on-year in October, the fastest increase in nearly eight years. Pork prices more than doubled in annual terms in October, according to China's statistics bureau, accounting for over 60% of the CPI rise.

BMW and Great Wall begin work on electric vehicle factory in China

Germany's BMW has broken ground for a new factory to produce battery-powered Mini cars in China, forging ahead in its partnership with domestic manufacturer Great Wall Motor despite a slowdown in the world's largest electric vehicle market, reported the Financial Times.

The partnership is the latest of several between Chinese and international automakers focusing on EV production in response to rapid growth in China's new energy vehicles, or NEVs, a category that includes both hybrids and fully electric models.

That growth has stalled in recent months after the government curbed subsidies for both buyers and manufacturers. The partnership with Great Wall would help bring down costs for electrification, especially for smaller cars, BMW chief financial officer Nicolas Peter told the Financial Times. Reducing such costs was the industry's "number one challenge".

International automakers have been left trying to balance the risks of overestimating growth in China's NEV market against the government's push for a fifth of Chinese car sales to be NEVs by 2025.

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Face2Face - Interview with Mr. Sumit Gupta

As Deputy Director, he supports the company for international activities related to Standard Revision, standard comparisons, supporting GOTS Approved Certifiers, and various other activities related to progress and interpretation of the standard. As Representative, his role involves creating more interest and awareness about 'Organic Textiles' at the level of producers, exporters, retailers, educational institutes & consumers.

His role also involves liaison with media, trade organisations and government. He has presented in various international conferences, seminars, colleges and companies and has been extensively working towards creating awareness about importance of Chemical RSL, Traceability, Social & Environmental compliances in textile industry.

Mr. Gupta has previously worked with Hohenstein India Pvt Ltd, which is the official testing body for Oeko-Tex Standard 100 in India. Before joining his Master's degree, he worked for a year in production department in Aarti International Ltd.

He was awarded with Charter Colourist (C. Col) by

Profile:
Mr. Sumit Gupta is M.Tech. & B.Tech., a sustainability professional in the field of Textile Processing. He has 11+ years of experience in Eco-Fashion, RSL, Chemical Compliance, Sustainability Management, Social Compliance, Technical Certifications, Eco-Labels, Content Marketing and Consulting. Currently, he is working with German Standard Organisation - Global Organic Textile Standard (GOTS) as their 'Deputy Director Standard Development & Quality Assurance' and also 'Representative in India & Bangladesh'.
Society of Dyers and Colourists, UK and Associateship (ASDC) by Society of Dyers and Colourists, UK. Also awarded with Gold Medal in B.Tech., being the University Topper in Textile Technology Department of Punjab Technical University, Jalandhar.

Q.: Sir, you are Textile Graduate, so how and where you have started your career?
Ans.: I completed my B.Tech in year 2006. I was awarded Gold Medal for being the University Topper. I started working in production department of Aarti International Ltd after graduation. After one year, I joined Institute of Chemical Technology (formerly UDCT) for M.Tech.

Q.: Can you walk through the memory lane and share with us about your memorable journey after passing M.Tech from ICT, Mumbai?
Ans.: Two years of M.Tech., from ICT were spent in intensive studies and research. I had the opportunity to work under the guidance of Prof. Dr. MD Teli. These studies further prepared me for the industry. I was also awarded the Mrs. Asha Khemani Memorial Best Student Award in Textile Department.

Post M.Tech., I joined Hohenstein India Pvt Ltd, the official testing body for Oeko-Tex in India. I had the opportunity to start their Ahmedabad office and lead that office. In March 2012, I joined Global Organic Textile Standard (GOTS).

Q.: Give us a brief introduction of Global Organic Textile Standard (GOTS) and are there any innovations or changes in criterian your Standards time to time?
Ans.: Global Organic Textile Standard (GOTS) is the world’s leading standard for processing of textiles made from organic fibres. The standard includes ecological and social criteria, backed up by independent certification of the entire textile supply chain.

GOTS versions are released every three years. Currently GOTS version 5.0 is implemented worldwide. GOTS Version 6.0 is scheduled to be released in April 2020. Every new version of GOTS is a result of a comprehensive stakeholder input process. Various international organizations with expertise in organic production, chemical manufacturing, textile processing and social criteria participate in the revision process. It follows the overall approach of GOTS to define high level verifiable environmental and social criteria.

Q.: What is GOTS Certification and how it is assigned to implement the quality assurance system?
Ans.: GOTS certification is done through approved Certification Bodies (CBs). CBs are assigned with the implementation of the GOTS quality assurance system (GOTS Certification). GOTS approved CBs are listed on our website.

CB will verify adherence to all aspects of GOTS criteria during on-site inspection of a textile processing unit. Non-conformities, if any, must be cleared within 60 days. Besides, testing of product for hazardous substance residues, drinking water quality, wastewater, etc. On-site inspection for chemical input suppliers is not included in current standard, but it might be included in future.

Q.: How does it helps to your licensees?
Ans.: There are numerous ways in which companies benefit from becoming certified to GOTS. Some benefits are it serves as comprehensive risk management tool for entire supply chain. Furthermore, it sets strict and extensive environmental and social criteria. Additionally, as a part of GOTS requirements, they work on improving energy and water use efficiencies in their respective operations, leading to improvement in productivity. Sustainability innovation adds value over conventional products.

Social and environmental conformance is necessary for the whole facility for the whole year, irrespective of number of organic orders processed in a year. Companies can communicate to their respective buyers about their commitment to sustainability by means of their GOTS certified status. This leads to increase in credibility of their claims as well as possibilities of getting bigger orders from reputed brands.

Q.: What are your requirements or the conditions to obtain GOTS certificate?
Ans.: Besides use of minimum 70% organic fibers, GOTS mandates processing of organic fibers in an environmentally and socially responsible manner.

Chemical inputs like dyes, inks, pigments, auxiliaries, enzymes, etc. must be approved prior to being used for processing of GOTS goods. The approval process includes testing for hazardous substance, biodegradability and toxicity requirements. Finished textile products are also tested testing for residues of hazardous substances.
Wastewater must be treated prior to discharge and the discharged water must meet further standard guidelines. Similarly, there are guidelines for solid waste and air pollution. GOTS criteria also includes ban on hazardous processes like sandblasting and ammonia treatment.

The section of social includes ban on child labour, forced labour, excessive overtime, etc. Besides, provisions for health & safety, fire safety, building safety, etc. must be in place.

Q.: How can certified entities get permission to use GOTS logo?
Ans.: The facility applying the label must formally ask its Certification Body for label design approval. Uncertified retailers can ask their suppliers to get the 'Label Release' from its respective Certifier. The artwork of the GOTS label must include GOTS logo, label grade, reference to certifier and license number. A consumer can verify the license number of GOTS Public Database.

Q.: Can you let us know about the latest technological innovations taking place in GOTS?
Ans.: GOTS has launched "GOTS Monitor (Water/Energy)" to help the licensees monitor their water/energy consumption and compare it with global benchmarks for their fabric/shade/machinery type etc. GOTS Monitor W/E also gives "Cost of Inefficiency" in financial terms. This helps the manufacturers to analyse their present situation. This also acts as a positive motivation to upgrade their processes to match the global levels. If the results are used to upgrade the processes involved, this can also act as a tool to enhance competitiveness in the international race. GOTS Monitor W/E is free to download and use for all GOTS licensees.

Q.: How GOTS observes Social Compliance in textile fields?
Ans.: GOTS has detailed criteria for social compliance (Section 3.0). If refers to relevant ILO conventions that are compulsory for all processing and manufacturing stages. Operators must establish social compliance management tools that support the implementation and monitoring of the social minimum criteria.

Companies must have a policy for social accountability to ensure that the social criteria can be met. They must support the implementation and monitoring of the social criteria.

Q.: How have you grown with a sustainable position in the global market?
Ans.: As an organization, GOTS has always believed in strong partnerships since its inception. GOTS actively engages with trade & consumer media, government, trade bodies and industry. As GOTS Representative in India & Bangladesh, I have been participating in several tradeshows, conferences, training programs, meetings and consultations across the country. Further, we support the stakeholders with several knowledge resources including videos, informational documents, factsheets and so on. We are released a factsheet on correct GOTS Labelling, which has been appreciated by brands and industry alike. Another holistic factsheet explains how GOTS helps to meet UN Sustainable Development Goals (SDGs). We are coming up with another factsheet on control of chemicals in GOTS. I invite you to visit the 'Information Centre' on our website. It includes interesting information for both industry and consumers.

Q.: Who are the key customers globally and how is the Indian market?
Ans.: As per Organic Cotton Market Report (OCMR) 2018 by Textile Exchange, global organic cotton production has increased from 107,980 MT to 117,525 MT. It registered a ten percent growth over last year. India's share in global organic cotton production was at 51%. India retained its position as the world's largest producer of organic cotton.

Top three countries that contributed to the global organic cotton volume growth are China, Tanzania & Uganda. India's organic cotton production for the year was 59,470 MT.

According to OCMR 2017, top 10 buyers of organic cotton textiles were C&A, H&M, Tchibo, Nike, Inditex, Lindex, Boll & Branch, Woolworths, Williams Sonoma and Stanley/Stalla. Besides, there are more than 25 international brands in the 100% Organic Club, which means that they only sell organic textiles

As per 2018 data from GOTS, number of GOTS certified facilities worldwide was 5,760. It showed an increase of 14.6% as compared to 2017 data. GOTS certified textile processing facilities are in 64 countries around the globe. We shall be releasing 2019 data in March 2020. Stay tuned!
Q.: Indian Government is supporting and granting various incentives to the Textiles and Garments. Do you have any expectations from Govt.?
Ans.: Since much more investment, policy interventions, renewed interest by private and public seed companies, and other stakeholder interventions are needed in organic cotton farming sector, an Official Endorsement from the relevant authorities in Ministry of Textiles, Ministry of Commerce, APEDA and Director General of Foreign Trade (DGFT) will enhance GOTS’ presence in India and will be highly beneficial to environment, society and organic textiles business in India.

GOTS is associated with QCI-UNFSS National Platform for Private Sustainability Standards in India and we are engaging with various stakeholders through that platform. We shall also be working towards getting recognition for responsible public procurement.

Q.: In your opinion what will be overall future of organic Textiles etc.
Ans.: GOTS mission is that organic textiles become part of everyday life of consumers. GOTS is a textile processing standard that begins with the first processing activity in textile chain, like ginning for cotton. It includes stringent environmental and social criteria at every processing step. In order to give a healthy life to our future generations, all of us must have a holistic approach towards our working. We must address the triple bottom line and work towards all the three aspects- People, Planet and Profit.

Q.: How do you see market segment growing in the next 5-10 years both locally and internationally?
Ans.: The potential of organic textiles remains underutilized in global and Indian markets. We need to consistently work together with media, NGOs, consumer organizations, retailers, designers and government to create more awareness in India.

Businesses must invest in social and environmental initiatives to reap long term economic benefits. Besides, close partnership and longstanding commitments with backward supply chain partners will lead to conversion of more land to organic and consistent supply during tough times.

Q.: At the end, what is your message to the Indian entrepreneurs?
Ans.: Domestic textile industry is undergoing a transformation, with sustainability and responsible luxury being the latest buzzwords. Scores of brands are offering organic textiles in Indian retail. More than ten brands I know are selling ‘certified’ organic textiles with GOTS label in India. We are working to increase both the number of such brands as well as the volumes.

Having said that, as the largest producer of organic cotton and organic textiles, India continues to be the world’s most popular sourcing destination for organic textiles. Responsible production practices are good for the planet and good for business at the same time!

Interview with VMS Fabrics
General information on VMS Fabrics Pvt Ltd.

VMS Fabrics Private Limited is a part of the well-known Lakshmi Enterprises, Ahmedabad, one of India’s leading trading houses for the supply of quality grey and dyed fabrics, which has been serving the Indian textile industry for more than four decades. They were sourcing fabrics since 1985 from 75 of the best corporate vendors in India. To meet their bulk requirement of quality fabrics, they ventured into manufacturing under a new company, VMS Fabrics Pvt. Ltd., which was set up in 2016. VMS recently installed the new, cutting edge KARL MAYER Prosize sizing machines to complement their Toyota high-speed air-jet weaving machines.

In an interview with A.T.E., Mr. Jay Shah, Managing Director of Lakshmi Enterprises, exudes confidence about the growth and prospects of this manufacturing venture.
A.T.E.: What are the key strengths of VMS Fabrics that will ensure the success of this new venture?
VMS: We have been sourcing the bulk of the fabrics we require only from the leading manufacturers of India. The new manufacturing setup will definitely boost our confidence and prosperity in the coming years as we will be able to serve both domestic and export-related needs through our in-house produced quality fabrics.

◆ We use only the best quality yarns from the Indian spinners as per our buyer protocol, which gives us the best output in terms of fabric quality and loom efficiency.
◆ We have the best technical team in marketing and manufacturing, which helps us meet the common goals of the group, and we have the best machines and working culture which assures the best output from each of the resources we have.

All these strengths help us produce the best quality and competitive products, which ensures buyer satisfaction. We are committed to provide quality fabrics to our customers. We have repeated orders from our exporters and have well-established clients outside India. We produce 1.5 million metres per month and are targeting 3 million metres by 2022. The growing demand and having our own set-up with state-of-the-art machines will surely help us to grow fast in this competitive market.

A.T.E.: Ahmedabad has always been a hub for fabrics trading in India. Do you see this continuing?
VMS: Yes, surely. There are many modern process houses in Ahmedabad that offer quality fabrics in shirtings, dress material, denim, bottom weights, Lycra, etc. The requirement of fabrics by the process houses will increase day by day and hence we foresee an overall growth in the weaving sector, as well as other areas in textile.

A.T.E.: You have been in the trading business for decades. Could you tell us how the idea of the sizing project came up?
VMS: As I mentioned, we have been sourcing the fabrics from almost all the leading weaving mills. Looking at the increasing demand from the process houses, as well as global challenges for fabrics such as rising prices, we thought that having our own manufacturing setup, in addition to our trading business, would not only help us meet our commitments to our customers, irrespective of the market situation, but also make our products more competitive globally. We set up the sizing unit to ensure backward integration and good quality warp beams for our weaving unit.

A.T.E.: What made you opt for KARL MAYER’s Prosize sizing machine?
VMS: We had been sourcing grey fabrics from South India and other weaving centres where all our suppliers have installed KARL MAYER Prosize sizing machines. All our suppliers are very happy with the performance of this machine in terms of high productivity, high quality warp beams, lowest wastage of yarn, optimum stretch control.

With reduced consumption of size chemical and other utilities, the Prosize is cost effective as well. The warp beams produced on the Prosize run smoothly on our high-speed air-jet weaving machines, and achieve the highest weaving efficiency compared to the beams produced with conventional sizing technology.

Keeping sustainability and growth in mind, we prefer to go with new technologies and machines. If we want to cater to the global fabric demand, we must have the best machinery that can produce the best quality products at competitive prices, to help us tap the international markets in future.

A.T.E.: What is the production you are able to achieve with Prosize sizing machine?
VMS: We have selected the machine configuration to achieve the maximum production speed. With a specified speed of 150 metres per minute for the KARL MAYER Prosize, and looking at the highest production speed achieved at all other installations of this machine, we are hopeful of achieving a production speed of 140 to 150 metres per minute for all warp qualities. We commissioned the Prosize machine along with the KARL MAYER high speed direct warper in March 2019. With this combination, we are running high speed weaving machines with the best installed efficiency in weaving units and can produce more than 12-13 tons per day of sized warp. The good quality of warp beams has helped improve the weaving speed. Our target is to produce 450 tons of sized warp per month with this machine.

A.T.E.: Could you share your experience working with A.T.E. as a business partner?
VMS: We have known the A.T.E. team for a long time. We have met them at our suppliers’ places from
where we source the fabrics and yarns. It was in one such meeting that the A.T.E. team convinced us to set up our own manufacturing unit. A.T.E. helped us not only to decide the right specifications of the warp preparation machines based on a wide range of weaving qualities, but also the layout, and the finalisation of the utilities and other important requisites for the project as well. We highly appreciate the timely support provided by A.T.E. and KARL MAYER.

**KARL MAYER - Even more denim excellence**

**KARL MAYER** has opened a new R&D centre for denim in Italy

![KARL MAYER - Opening of new R&D centre for denim](image)

KARL MAYER ROTAL expanded its denim centre of excellence with an in-house show for its customers and celebrated at the same time the 50th anniversary of its birth. There is now a brand new competence centre featuring a GREENDYE pilot installation, academy, show room and meeting rooms in an area covering 500 m². The expansion offers customers new opportunities to make their production more efficient and sustainable, as demonstrated by an event programme that included a factory tour, machinery show and specialist presentations. Around 34 representatives from international customers accepted the invitation to Mezzolombardo.

The guests were particularly impressed by the 13-metre-long pilot installation. The equipment is used to simulate the environmentally friendly and efficient nitrogen dying technology in real-life conditions on a scale of 1:10. In addition, KARL MAYER ROTAL stands out thanks to its comprehensive service. "The customers can come to us with their yarn. We dye and warp it, and working with our Italian partners, we then turn it into woven fabrics that are comparable with previous products. Many guests were I was even able to discuss some specific projects," said Stefano Agazzi, Chief of Technology and Products, when summarising the event's success.

**KARL MAYER - Establishing and maintaining contacts**

KARL MAYER successfully participated in Techtextil India, held 20-22, November 2019 in Mumbai.

![KARL MAYER's stand at Techtextil India](image)

KARL MAYER used Techtextil India in order to show new warp knitting and warp preparation technologies as well as innovative textile product developments. At the trade fair, this global player was present with a lecture of its Regional Agent, A.T.E., held during the accompanying symposium, and with a stand. Both presentations met with great response. "The exhibition was smaller than expected but very well visited", said Mark Smith. The Sales Manager of KARL MAYER's Warp Knitting Business Unit was able to welcome many of his customers, and could establish new contacts also to non-technology-related manufacturers.

Important topics of his conversations were delicate magazine weft-insertion net curtains patterned with fancy yarns, in woven-fabric look, and the appropriate machines - the TM WEFT and the WEFT.FASHION NEWS
TM 3. The conversation partners included many warp knitting companies that want to set up a second mainstay with home textiles, but also net curtain weaving mills in search of new product lines. In high demand both by warp knitters and by weavers was the terrycloth tricot machine, type TM 4 TS. Of particular interest in India is the possibility to produce towels with neat and sturdy edgings, thus, saving the edge seams.

Erik Junghans, Sales Manager of KARL MAYER's Business Unit Technical Textiles, was also satisfied with the outcome of the trade fair. Especially during the Techtextil Symposium he was able to establish many new contacts. Among the major topics of discussion were textile products for the building industry. "In India there is a considerable interest in textile-reinforced concrete. So far, no suppliers are on the market in this respect, but the national trade association, ITTA, wants to promote developments in this field. We have the suitable machines, but with our contacts to German research institutes we also want to give our support accordingly", explains Erik Junghans. He also witnesses a growing demand for warp knitted geotextiles in India. To increase the service life of roads, the government especially promotes projects with geogrids. In addition, on the KARL MAYER stand there was a lively exchange on multiaxial machines intended for the efficient manufacture of composites made from glass. The lightweight materials are in special demand by the wind energy industry, for the rehabilitation of pipelines, and for the construction of cabins for buses and trains.

As third player in KARL MAYER's Business Units, the Warp Preparation BU successfully used the Techtextil India for networking opportunities.

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KARL MAYER GROUP - New information and developments

Rapid ordering of spare parts - it's in your hands!
An upgrade of the WEBSHOP SPARE PARTS platform is on the starting line

KARL MAYER is expanding its WEBSHOP SPARE PARTS platform in order to support its clients in their day-to-day operations even more effectively. With a number of new functions, this online ordering platform is now even more useful. This manufacturer is "beating the publicity drum" even harder - to disseminate more information about it. A new film was being premiered at ITMA 2019 in Barcelona, showing the webshop, together with its functions and advantages. The WEBSHOP was also celebrating a first for the warp preparation sector at this leading trade fair. It was being successfully presented to clients with all the existing functions, together with the web shops that have already been installed. Webshops for the KARL MAYER's business units are also being presented at specific trade fairs. The Webshop for Technical Textiles was being promoted at the JEC World exhibition in March 2019, which generated a great deal of interest.

Extending the online procurement of spare parts for technical textiles
The WEBSHOP SPARE PARTS for Technical Textiles began on a small scale in 2017, and has been expanding gradually ever since. By the end of 2018/19, the range covered more than 3,200 items - so it was time for a relaunch.

The ordering platform, with specific actions, was pre-
sented to a wide circle of customers and was very well received. The webshop for KARL MAYER Technische Textilien is now being used by customers from 13 countries. "We are extremely pleased, and we are increasingly expanding our spare parts business via our webshop," said Jessica Schwabe from KARL MAYER Technische Textilien in July 2019. She found a new innovation, which was unveiled at ITMA, particularly useful: this was the setting up of the central access address, shop.karlmayer.com, which directs the user straight to the webshop that has been made available to him. Alternatively, he can select the webshop that he wants to use via a landing page.

An upgrade that increases efficiency
In the latest upgrade, the WEBSHOP SPARE PARTS has been extended by the ability to specify the delivery times. In addition to the standard delivery times, an additional display now also gives information on the current availability of selected items, as a function of the number of pieces required. This new function gives the customer optimum support when planning his requirements. The WEBSHOP SPARE PARTS for Warp Knitting also offers some new functions that go beyond the conventional procurement of spare parts. This extended feature relates to work on the machine operations of the customers on site. KARL MAYER has linked service packages for standard applications to meet the requirements of its customers. The focus here is on the mechanical and electrical work, which can be booked via a contact at KARL MAYER. For example, if a customer is intending to change the gauge on his HKS machine, or if he is planning to update the software, he can obtain information on the type and extent of the work and which person to contact in the webshop under the heading of SERVICE Packages. In addition to the use of personnel on site, the package includes selected web seminars from the KARL MAYER online training programme. The cross-selling features have also been extended as part of the process for expanding the contents of the webshop. This now contains even more cross-references to the associated products.

Easy access and switching
To provide additional support, the procurement of spare parts has also been made more mobile. For example, the k.maintenance app from KM.ON allows direct access to the WEBSHOP SPARE PARTS. This practical app can also be used for the Scan-to-Order function for simple ordering, and the Check Parts function for quickly checking the authenticity of the spare parts.

A special symbol in the delivery note enables a switch to be made easily from conventional ordering to online ordering. Every product shown in the document, together with its availability in the webshop, is marked by a shopping cart symbol. By specifying a code, subsequent orders can also be placed very easily using the Scan-to-Order function. This practical symbol will soon be transferred to other documents.

Maximising efficiency and halving loss
KARL MAYER has developed 2”-guide units with separable 1”-segments for maximum efficiency when threading the ground guide bars of its warp knitting machines. These long units reduce the time needed for retreading the guide bars compared to the current 1”-types, and they eliminate the disadvantage of the current 2”-units in the event of any damage. Previously, the entire 2”-unit had to be changed if there was a defect in a guide, but now just the 1”-section with the defect can be removed easily and replaced separately.

Huge interest in a "breath of nothing"
New developments in weft-inserted net curtains have ethereal grounds made from monofilament yarns in their sights.

Net curtains produced on warp knitting machines with magazine weft insertion are the perennial "evergreens" in the window fashion sector. KARL MAYER is now coming like a breath of fresh air onto this established market segment, and is offering some specific new developments. Its latest machine, the WEFT.FASHION TM 3, can produce articles having an on-trend look in the style of popular gauze-like fabrics made from monofilaments and fancy yarns, yet it enables fabrics to be produced without sizing at a production rate that
is 10 to 11 times higher than that of comparable looms.

The nature of the technology also means that the lightweight, transparent, warp-knitted fabrics have a high slip resistance. These advantages impressed the visitors at the last ITMA fair in June 2019 in Barcelona.

During this important trade fair, KARL MAYER was showing a collection of on-trend, weft-inserted net curtains produced on the WEFT.FASHION TM 3, which generated a great deal of buying interest. The Turkish visitors in particular asked a great many questions. Encouraged by the positive feedback, the textile specialists at KARL MAYER carried on with their development work, and processed fine monofilament rather than multifilament yarns on the warp knitting machine with weft insertion. In the first stage, a lustrous yarn of dtex 22 was processed in all the yarn systems. A very delicate, extremely transparent, feather-light fabric with an organza ground was produced, which weighs just 20 g/m². Despite its ethereal look, the fabric is extremely stable and is suitable for embroidering. The textile developer, Kay Burkhardt, is particularly pleased with the look of the fabric. “We processed a very dense structure at 35 stitches/cm to produce an extremely uniform appearance.” When hanging in front of the window, the net curtain creates a subtle interplay with the light to produce shimmering, glittering and moiré effects in all the colours of the rainbow. In subsequent development stages, a ground made from monofilament yarns was combined with a weft made from different fancy yarns. Yarns featuring knops, nodules and crimps were processed and - what was particularly ingenious - a relatively thick yarn was used, which was first formed into a cord-like structure by pillar stitches. The optically dominant weft materials almost hide the ground. Completely new textile constructions are produced, which will stimulate the trend for net curtains with puristic-looking yet discreetly subtle patterns.

**Protection against gunslingers**

New, lightweight aramid textiles - more protection than weight

Aramid fibre yarns are now widely used in technical applications. They are used in composites, for example, in hard ballistic systems, lightweight transport containers and laminated, high-performance sails, but they are also used in protective textiles - usually in woven textiles - for clothing. Compared to glass and carbon fibres that are also used, the specific characteristics of aramid yarns give them advantages that can be used in a wide variety of applications - but these come at a price. In particular, they have an exceptional impact resistance and energy absorption capacity. Unlike the versions made from carbon or glass, the aramid fibres are virtually undamaged by filament abrasion during
processing. They can currently be processed on the COP MAX 5 multiaxial warp knitting machine to produce non-crimp fabrics with a degree of uniformity that has never been achieved before. Fine, lightweight, channel-free reinforcing structures are produced for use in applications requiring a high level of force absorption, especially in new and lighter, soft ballistic systems. We reported on the unique aramid structures produced on the COP MAX 5 in "Kettenwirk-Praxis", issue 02/2018. This article deals with the subsequent development work.

Online spreading and fabric production
KARL MAYER Technische Textilien GmbH set up a far-reaching development project, entitled "COP MAX 5 Aramid", for processing high-performance fibres on multiaxial warp knitting machines. The aim of the project was to produce flat reinforcing textiles for composites having a low weight and a uniform fibre distribution. The surfaces of the finished textiles should have a dense structure, without any so-called laying channels. The fibre materials can be used to the maximum, thanks to their exceptional uniformity - which justifies the cost of the aramid yarns. The TC 66 online spreading unit and the COP MAX 5 Aramid multiaxial warp knitting machine were used to produce the new, lightweight textiles. The spreading unit ensures that the aramid yarns are spread to produce thin tapes, which are fed to the COP MAX 5 Aramid at a constant tension. The multiaxial warp knitting machine bonds the delivered material stitch by stitch to produce high quality, non-crimp textiles with a huge potential in the lightweight construction sector. The process runs discontinuously between the machines. The aramid material has to be cut following spreading and before laying.

Continuing work on the project
In the first stage of the project, a new tape cutting unit was developed as part of a thesis, which was specifically designed for cutting aramid tapes. This new system could be used to produce single layer, non-crimp fabrics with a laying angle of -45° and a virtually channel-free fibre arrangement, weighing just 120 g/m². The work on this stage ended in March 2018. The thesis was awarded a classification of "very good" at the Technische Universität Dresden (Dresden University of Technology). The second stage of the project involved extending the single fibre layer produced by another layer running in the opposite direction. To do this, the aramid cutting unit that had been developed was further optimised and complemented by a second unit. A new cutting unit was also added at the machine exit point to remove the textile structures produced reliably from the transport chain.

Biaxial textiles with a unique potential for producing lightweight structures
The second stage of the project resulted in the development of biaxial, non-crimp fabrics with laying angles of ±45°, which deliver a completely new level of performance for the lightweight construction sector. The reinforcing textiles have an exceptionally flat surface and a uniform distribution of the aramid fibres - since there are no wavy or twisted yarns. Compared to conventional biaxial textiles produced on the COP MAX 4 or the COP BIAX based on a yarn laying process, the filaments have a much higher covering power. Intermediate film layers for compensating for channels and irregularities are no longer needed with the COP MAX 5 Aramid, so they are virtually a thing of the past. The fabric weight is also quite unique. The new textiles made from aramid tapes having individual layer weights of 90 g/m² and yarns having a count of 3,360 dtex with 2,000 filaments now weigh just 180 g/m². Up until now, aramid structures produced on the COP MAX 4 or the COP BIAX from expensive yarns with a count of 450 to 960 dtex could only be produced with up to 200 filaments, which means that they would then weigh 250 to 500 g/m². The COP MAX 5 Aramid technology also scores points in terms of costs: relatively coarse and economical aramid yarns can be processed into fine reinforcing structures, and there is less edge waste from the textiles. Compared to the simple yarn laying process, the potential savings could amount to thousands of euros a week!

Triaxial textiles are on the horizon
The developers at KARL MAYER Technische Textilien GmbH have hit the nail on the head with this new technology. This was clear from the reaction to the latest results of the project at various trade fairs this year. The technology generated at great deal of interest - especially at Techtextil in Frankfurt and the JEC in Paris.

Enquiries came from producers and organisations involved in protective clothing, and especially soft ballistic protection. But clothing companies in search of a second business opportunity were also keen to learn more about it. "Our business partners describe the new biaxial textiles as uniquely lightweight and uniform. They see a huge market potential for this new technology, and have encouraged us to take it further," says Rainer Seuß, Product Management, and Composites. Ques-
tions were asked in particular about the protective effects of triaxial textiles for use in ballistic systems. For this reason, the technologists specialising in applications technology would like to develop a non-crimped construction with laying angles of -45°/90°/+45° for use in effective systems having a low weight, which would be acceptable to the wearers. When talking to people at the fair, Rainer Seuß discovered that, "Every kilogram saved in a ballistic jacket means that the soldier wearing it can carry an extra kilogram of equipment/supplies." Lightweight, thin, soft ballistic vests can also be worn discreetly yet effectively under the polo shirts of security personnel. In this case, customers would expect the aramid fabric to weigh 270 g/m². Alongside the developments made by KARL MAYER Technische Textilien, the fibre specialist, Teijin, has also been expanding the potential of aramid for use in lightweight structures. Aramid yarns having a count of 2,000 dtex with 2,000 individual filaments have been launched recently.

Electrifying sportswear

KARL MAYER's smart shirt with integrated sensors is opening up new applications

Since 2018, KARL MAYER has been developing highly efficient technology for producing functional warp knits with electrical conductivity under the concept of TEXTILECIRCUIT and is, therefore, setting the trend in electronic wearables. The special feature of TEXTILECIRCUIT is that conductive yarns can be incorporated directly into the textile during the warp knitting process, and they can be positioned in any location and in any design. Functional elements, such as sensors, conductors and coils, can be placed exactly where they are needed. No additional production sequences are needed whatsoever, and the textile characteristics are fully retained.

T-shirt with measuring functions

In the first stage of the development work, comfortable cuffs for remotely controlling robots, and textile charging stations for the inductive charging of smartphones were produced. A smart shirt with measuring functions was produced during a follow-up project. This functional garment was effectively demonstrating the possibilities offered by TEXTILE-CIRCUIT to a wide audience at ITMA 2019. It measures the heart rate, the moisture levels in the textile, and the temperature of the skin. The sensors needed to do this are integrated into the textile in a single step and transmit their recorded signals via an insulated conductor for processing in a mobile electronics unit.

The results can be called up on mobile devices via Bluetooth. The values measured for a cyclist were being displayed impressively on a huge display at ITMA 2019. As well as delivering functionality, this smart shirt also provides exceptional wear comfort. The flexibility of the conductive surfaces and the bi-elasticity of the fabrics deliver exceptional freedom of movement, and the textured polyamide filament yarns processed provide a soft touch.

New market potential

The performance of TEXTILE-CIRCUIT is opening up completely new market opportunities. "I talked to users from a wide range of sectors during the course of working on the project and attending trade fairs. I was surprised at the wide variety of ideas they came up with for using our textile sensor systems," explains Sophia Krinner. This Product Developer, Textile Technology, at KARL MAYER sees a huge potential for them, especially in the sportswear, workwear and healthcare sectors. Sophie Krinner also said that she had had many enquiries about buying the conductive, warp-knitted textiles Encouraged by this feedback, she is carrying on with her development work. Further stages will focus on improving the finishing of the textile and optimising the sensor technology. More information on TEXTILE-CIRCUIT will be available on stand 408 in hall C2 at ISPO Munich, which is taking place from 26 to 29 January 2020.

Texttreasure

Science is a way of thinking much more than it is a body of knowledge

- Carl Sagan
Lenzing debuts VEOCEL™ in India

The brand aims to lead the dialogue on sustainability in beauty

After successfully establishing sustainable fibre brands such as TENCEL™ and ECOVERO™, Lenzing now brings to India its beauty and body care fiber brand VEOCEL™. Derived from renewable raw material wood, VEOCEL™ provides natural care, every day, and is committed to driving industry standards around sustainability and natural comfort in the nonwovens sector. VEOCEL™ fibers are certified clean and safe, biodegradable, from the botanic origin, and manufactured in an environmentally responsible production process. With changing consumer habits, more and more nonwoven producers are shifting their product pipelines towards natural and eco-friendly materials to enhance product appeal and open more business opportunities. Lenzing being a pioneer in innovation has helped in fulfilling these needs through a more incorporating VEOCEL™ fiber in a diverse range of products.

Blending VEOCEL™ branded fibers with other fibers adds a greater degree of smoothness and absorbency to nonwoven products and will significantly improve the liquid absorbency in products like wet wipes, offering a more convenient way to clean surfaces. VEOCEL™ brand offers a broad range of applications that cater to daily use, including beauty, baby care, body & intimate care and surface cleaning. Consumer Applications such as face sheet masks, facial cleansing wipes, deodorant wipes, baby wipes, hand sanitizing wipes, intimate wipes, diapers, sanitary napkins, disinfectant wipes, etc. made using VEOCEL™ branded fibers have distinctive features such as strength, absorbency, liquid management, biodegradability while giving additional features like comfort, cloth-like feel, and smoothness, making it a viable eco-friendly option to choose from.

Worldwide efforts advancing towards eco-friendly plastic alternatives have skyrocketed in recent years, as different stakeholders are eager to make a difference in their field of expertise. When it comes to personal care products, fiber transparency becomes an important benchmark in determining the sustainability of products such as wipes and facial sheet masks. The soon-to-be-published European Union Single-Use Plastics Directive had identified wipes as one of the ten most polluting items found on European beaches and calls for clearer marking requirements, which shall disclose the presence of plastic materials in wipes and disposal options on the product packaging. This concern plagues India and as the country moves towards getting rid of single-use plastics by 2022, there would be no better time than now for Lenzing to bring VEOCEL™ to Indian beauty and home brands. With brands currently using materials that are single-usage applications and do not possess processes that reduce the ecological footprint, there is a need to bring about fiber options such as VEOCEL™ into the Indian market. Global beauty brands across Europe, USA, South East, and North Asia have now been using VEOCEL™ fibres as part of their product range, making a change towards sustainable living.

Commenting on this foray, Avinash Mane, Commercial Head - Lenzing South Asia said "2019 has been an exciting year for Lenzing. Earlier, we forayed in footwear with TENCEL™ and now beauty and body products with VEOCEL™. We are confident that brands and consumers will also welcome VEOCEL™ and appreciate the experience our fibers create. We will continue to drive innovation and transparency efforts in the nonwovens segment and work closely with industry partners to co-create a more nature-friendly future. Since the inception of the VEOCEL™ brand, we have been pioneering the development and application of sustainable nonwoven technologies and applications. Promoting a circular economy will continue to be a key strategy of the Lenzing Group."

According to the Hot Button Report of Canopy, a Canadian non-profit organization, Lenzing is ranked as one of the best performing viscose producers worldwide for its sustainable wood and pulpsourcing practices. Lenzing, as a nonwovens fiber producer and advocate for sustainability, has taken an industry-first step to enable consumers to make eco-conscious choices.
**Background**

Jeyavishnu Clothing Private Limited is a textile processing house based in Tirupur, India. It currently has a setup of 14 dyeing machines, the largest being an 1800 kg soft flow machine and smallest being a 250 kg machine. These machines require large quantities of hot and cold water during initial filling and subsequent cycles.

Challenges

Jeyavishnu Clothing Private Limited had designed a filling system with multiple pumps, which was functional but posed challenges during the initial filling. They were never able to fill all machines simultaneously. To overcome this, the dyeing machines were staggered to work as per the pumps' capacities. They had also not explored options to reduce filling time. This effectively meant that the mill could not optimise production from these dyeing machines.

The pumping system used by Jeyavishnu Clothing Private Limited to supply hot and cold water into the 14 dyeing machines was resulting in filling times of between 8 to 20 minutes. Based on the available capacity of pumps, Jeyavishnu Clothing Private Limited believed that this was the best possible performance.

A study conducted by the A.T.E. team highlighted that while the pumps selected were good, they were not operating according to the logic of production demand resulting in sub-optimal performance.

The solution

As recommended by A.T.E., Jeyavishnu Clothing Private Limited installed two TeraFlow hydro-pneumatic (HyP) systems each with a flow rate of 180 m³/hr.

TeraFlowHyP systems are always tailored to user requirements. They are made up of centrifugal horizontal or vertical pumps, pump logic controllers, and a diaphragm tank which respond to any change in pressure thereby ensuring a constant flow to the desired process or processes. At Jeyavishnu Clothing Private Limited, since the dyeing machines are of different capacities, the demand for water varies. It is difficult to forecast a typical consumption pattern. Hence the system needs to be robust enough to manage variations in demand without adversely impacting the performance or the life of the pumps.

Result

The TeraFlowHyP systems resulted in a reduction in the filling time per cycle by almost 80%. The filling time in first fill was reduced by more than 10 minutes. That is not all, the TeraFlowHyP systems offer some additional benefits as well -

- **Reduction in filling time per cycle results in more number of cycles per day**
- **Variable Frequency Drives (VFDs) ensure maximum power saving and minimum wear and tear of pumps leading to longer pump life**
- **Automatic pump switch**
- **Jeyavishnu Clothing Private Limited is naturally quite pleased with the performance of A.T.E.’s TeraFlowHyP systems**.

Mr. Balamurugan, Plant - General Manager, Jeyavishnu Clothing Private Limited says,

"A.T.E. made it simple - We are quite happy replacing our old filling system with A.T.E.'s TeraFlow hydro pneumatic pressure boosting solution for tank filling application in the dyeing process. The old system posed challenges during the initial tank filling and also could not meet demand-supply equation resulting in sub-optimal performance. A.T.E. TeraFlowHyP systems helped to meet demand-supply equation and reduced the filling time per cycle by almost 80%, reducing the filling time by more than 10 minutes and ensuring a constant flow throughout process.

Performance of A.T.E.’s TeraFlowHyP systems and prompt after sales services is satisfactory."
SZ&W Group is organizing 'Textile and apparel SEA Summit 2020', scheduled to be held on March 19-20, 2020 in Ho Chi Minh City, Vietnam.

Southeast Asia is playing an extremely important role in textile and apparel industry. SEA has strong comparative advantages for manufacturers (market access, low labor costs, investment incentives and existing industrial basis). In the meanwhile, rising wages, unskilled labor force and international completion are the main challenges. Textile and Apparel Industry is developing rapidly in Vietnam, Myanmar, Cambodia, Bangladesh, India and other countries in Asia, among which Vietnam is the leading country with rapid growth. Vietnam exports apparel and textile products to 180 countries. Forecast shows the local textile and garment industry will maintain high growth potential until 2035 with an estimated export turnover of about US$200 billion.

Textile and Apparel SEA Summit 2020
Aims to provide the opportunity for industry chain stakeholders to win textile and apparel business and ensure growth in SEA Region. It will grasp the latest opportunity and trends, together with good practice sharing to accelerate industry upgrade and development. Relevant high-level leaders will discuss the highlights on Policy, Current Situation, Opportunities, Sourcing Strategy, Supply Chain Management, Raw Materials, Production, Technology Upgrade, Quality Assurance and Sustainable Development.

Register Now
If not joined this event yet, book seats now and do not miss the most influential textile and apparel summit covering the SEA region.

Please check Textile and Apparel SEA Summit 2019 post report to learn more about Textile and Apparel series summit.

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Lenzing unveils REFIBRA™ breakthrough technology strengthening their commitment

◆ Lenzing has unveiled their latest REFIBRA™ technology breakthrough, which features the industry’s first successful scaled production of virgin TENCEL™ Lyocell fibers using post-consumer cotton waste.

◆ TENCEL™ Lyocell fibers with REFIBRA™ technology now feature up to 30% of recycled raw material content, where some post-consumer cotton waste is mixed with pre-consumer cotton waste.

◆ Lenzing’s five-year vision is to raise the industry bar by producing fibers with REFIBRA™ technology by having up to 50% recycled content from post-consumer cotton waste to make textile waste recycling as common as paper recycling.

Lenzing Group announced today another breakthrough for its pioneering REFIBRA™ technology with the industry’s first successful production of TENCEL™ Lyocell fibers using post-consumer cotton waste as part of the recycled raw material proportion.

Currently, REFIBRA™ technology feature the upcycling of a substantial proportion of pre-consumer cotton scraps from garment production and mixing with virgin wood pulp, to produce new TENCEL™ Lyocell fibers. In September 2019, Lenzing announced the first-phase of REFIBRA™ technology upgrade, by increasing the composition of pulp made from upcycled cotton scraps collected from garment manufacturing process to up to 30%. In the second-phase, amongst the 30% of recycled raw material content, Lenzing can incorporate up to 10% of post-consumer cotton waste into the mixture of recycled materials alongside pre-consumer cotton waste. TENCEL™ Lyocell fibers with REFIBRA™ technology are produced on demand and capacity can reach thousands of tons for both generations.

"Our world's forests and climate need these kinds of Next Generation Solutions at both scale and speed in the cellulosic fiber sector. Canopy applauds Lenzing for the vision of making textile waste recycling common place and for launching this commercially available product line with the first steps of post-consumer recycled content," said Nicole Rycroft, Executive Director of Canopy. "We look forward to Lenzing’s leadership as they work to significantly increase the volume of their raw material that comes from Next Generation feed-stocks, and we know brands and retailers are looking to preference producers who hit the goal of a 50% post-consumer recycled fiber line first."

With growing interest around the concept of ‘circular economy’ across the globe, the scaled production of TENCEL™ Lyocell fibers using post-consumer cotton waste is a key milestone for Lenzing’s pursuit to build a fully sustainable textile ecosystem.

The second phase upgrade of REFIBRA™ technology poses tremendous business opportunities and helps drive greater developments for circular economy. Lenzing believe that the growing adoption of recycled textiles is an essential part of the fiber industry’s future growth strategy. Such frontier production model can help revolutionize the fashion industry and empower brands who are looking for eco-responsible textile value chains. It is the vision of Lenzing to make textile waste
recycling a common process like paper recycling.

Based on the UN Sustainable Development Goal (SDG) 12, Responsible Consumption and Production, it is Lenzing’s clear vision to produce fibers with REFIBRA™ technology using post-consumer textile waste as raw materials. Being able to use discarded garments consisting of a wider range of materials will greatly enlarge the raw material basis for textile recycling. This innovation is a groundbreaking step towards tackling the global issue of textile waste disposal. At the same time it reduces the extraction of wood as a raw material and relieves the pressure on global forest ecosystems. Our vision includes recycling of fabrics and garments from Lenzing’s own materials. Lenzing is the first producer of wood-based cellulosic fibers offering Global Recycling Standard (GRS) and the Recycled Claim Standard (RCS) offering perfect transparency for the materials used during production. Produced in eco-responsible closed-loop production process, fibers produced using REFIBRA™ technology are 100% bio-based. The fibers will also feature properties of enhanced breathability through good moisture management, silky smoothness and strength.

By leveraging such innovative breakthrough, Lenzing has been working closely with brands and industry stakeholders to pursue a more collaborative driving force for the transition towards greater inclusive and circular economic growth.

"For several years, we have witnessed a rise of eco-consciousness amongst consumers. Consumers have been demanding more sustainable product options in their shopping list. If a company wants to truly improve its sustainability practice, it needs to reexamine its current business model and consider introducing new products or technologies with recyclability and reusability in mind. At Lenzing, sustainability is part of our DNA, and we will continue to stand at the industry forefront to assist businesses with the implementation of eco-practices in their operations," said Florian Heubrandner, Vice President of Global Business Management Textiles of Lenzing.

More information about the upgraded REFIBRA™ technology can be found here.

For more information please contact:
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Liva's participation in Yarnex Ludhiana receives overwhelming response

Promoted sustainable fabrics & innovative styles

Liva, the new age fabric brand from Birla Cellulose participated in the 17th edition of Yarnex which was held in Ludhiana from 20th-22nd December 2019. Being one of the most successful textile fairs in Ludhiana, the show witnessed 5400 visitors and participation of 90 exhibitors. It was a huge platform to connect with the textile value chain across the North India region.

Liva along with its reputed LAPF partners showcased innovative products in knits, women's woven wear and stoles.

The Liva Pavilion witnessed participation from leading LAPF partners Krishna Textile Process, Feather Soft, Galaxy Stoles & Alla Moda Knitwear. These esteemed partners presented the latest innovative fabric collections in Birla Spunshades and Birla Modal fibre. The brand received a positive feedback on the initiative of enriching customers with new products knowledge along with support to players in industry to grow with LIVA. The LAPF partners also secured great business leads from the exhibitions.

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MLV Textiles celebrated its 25 Years of Togetherness

On the completion of 25 years of meritorious services to the cause of promoting scientific and technological knowledge, The Textile Association (India) - Rajasthan Unit celebrated its Silver Jubilee with great pomp and show. To celebrate the event, a National Conference was organised on 17th August 2019 at SHRILOK RESORT, Bhilwara on the theme "Textile industry- Opportunities and Challenges" with a special focus on Rajasthan. It was indeed a landmark occasion for The Textile Association (India) - Rajasthan Unit.

On the onset, Dr. Dhirendra Kumar Sharma, Honorary Secretary of the association welcomed all the present guest and members for the program. He informed about various activities being under taken by the unit. Rajasthan Unit president Shri R. L. Nolkha informed the audience about the role played by unit in various capacities during last 25 years. Shri Subhashji Baheria, Member of Parliament, Bhilwara Constituency and Chief Guest of the function applauded the various activities organised by Rajasthan Unit Bhilwara. Shri Ladu Ram Bangur, Chairman, Kanchan Group of Industries and Guest of Honor for this function stressed need of such plate form for helping the government in formulating policies.

Shri Arvind Vashishtha, Honorary treasurer of the association finally thanked to one and all who had contributed in making this event a memorable one. Special thanks were extended to the organizing committee members, Shri J. C. Laddha, Shri Deepak Agrawal, Shri Rajeev Jain, Shri Madhu Sudan Nuwal and Shri Vijay Agarwal.

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Dr. B. K. Behera, Professor IIT Delhi, Shri S. N. Modani, MD, Sangam India Limited, Shri Sanjeev Israni and Shri Gopesranjan Das from RIL, Dr. Rajesh Agarwal and Dr. Navdeep Kumar were some of the eminent speakers in the Technical Session. A spectacular Sufi music performance was also organized in the event. It was a great success by all standards. More than two hundred members gathered from all corners of India to participate in this Silver Jubilee Celebrations.

The celebration marked the glorious journey of last 25 years. Unit is acquiring a new milestone in contributing to the growth and development of textile industries and playing a major role in achieving the goals of Textile Association India.
Oerlikon Neumag at DOMOTEX 2020

BCF S8 with CPC-T - color separation has never been so easy.

OerlikonNeumag promises more flexibility in the color pattern design of carpets with the latest carpet yarn system BCF S8 at DOMOTEX 2020 in Hanover. All trade fair visitors can convince themselves of the possibilities for product differentiation in Hall 11, Stand A36.

Multi-colored carpets are becoming increasingly popular and the desire for significantly more flexible color mixing variants for product differentiation is increasing. OerlikonNeumag has focused on this and developed the BCF S8, a platform that leaves nothing to be desired when it comes to the color separation of tricolor yarns - from mélange to strongly separate.

Over 200,000 different shades out of three colors
The core component in this process is the new, pending Color Pop Compacting Unit (CPC-T) for an even more flexible and even color separation. Individually controllable air pressures per color in the CPC-T provide a pre-tangling, which results in an accentuation of the colors and thus enables over 200,000 different shades.

Color Pop Compacting also for PA6 yarns
Until now, it was difficult to produce highly color-separated or accentuated BCF yarns from polyamide 6, but in the future, this will be possible thanks to the CPC-T. Thanks to the new design, the CPC-T is now also suitable for processes with low thread tensions.

RoTac³ tangle unit with extensive modifications
Significant technological changes to the RoTac³ tangle unit lead to even more efficient BCF yarn tangling. On the one hand, the nozzle has been optimised flow-wise so that the air pressure can be reduced by approx. 10% compared to the previous version with the same knot strength. Furthermore, the nozzle bearing arrangements have been improved. As a result, either higher speeds or nozzle rings with a higher number of holes can be driven, which results in even more knots in the yarn.

The RoTac³ is part of the standard scope of delivery for the newer BCF S8. The tangle unit is optionally available for the single-thread Sytec One plant as well as for the three-thread S+ and can be retrofitted on request.

Oerlikon Manmade Fiber solutions for PET carpet applications now cover a range from 0.5 to 30 dpf
In addition to the BCF S8 technology described above, Oerlikon Manmade Fibers offers another system concept based on a POY and texturing process. This configuration is designed for a carpet and home textile product range, which is based on a very soft and puffy polyester thread with BCF-like properties due to the small dpf. The target is yarns with a titer up to a maximum of 1300 dtex and typically over 1000 filaments.

Typical products are, for example, a 1300 dtex f1152 or 660 dtex f1152 and 990 dtex f768. The machine concept consists of the well-known WINGS HD POY winder and the new eAFK Big-V texturing machine.
Oerlikon has invited all visitors to this year’s Shanghaitex in China on a journey into the future of manmade fiber production. From 25 to 28 November 2019, the world market leader showed all its guests its vision of a sustainable and automated manmade fiber production at its 100 m² stand in Hall E1, D20: "Clean Technology. Smart Factory." was themotto of the future. And this was only a stone’s throw away from reality at the stand. Because today Oerlikon was presenting the four ITMA Barcelona world premieres for efficient machine and plant concepts in a new, innovative industrial design. Together with numerous other innovations, all this forms the new DNA of the Oerlikon Manmade Fibers segment.

Launched to create new standards in texturing: the eAFKEvo generation of machines promises superior speeds, greater productivity and consistently high product quality, along with lower energy consumption and simpler operation vis-à-vis comparable market solutions. Oerlikon Barmag showed these wideranging capabilities at the trade fair with a high-end design from the new system platform. In particular, the numerous value-added features include two that are excelling with cool technology: the optimizedEvoHeater and the EvoCooler, a completely newly-developed active cooling unit.

WINGS FDY is now also newly available for the polyamide 6 process. With this development, the tried-and-tested WINGS technology - to date well-known for FDY yarns from polyester manufacturing - is now also available for the challenging polyamide 6 process. This new 24-end winding concept makes the efficient production of FDY PA6 yarns a reality.

Extending the polyamide yarn production from 12 to 24 ends with DIO and WINGS FDY pays yarn producers dividends, particularly in terms of investment expenditure (CAPEX) and operating expenditure (OPEX): significant savings with regards to energy, footprint and - due to the more ergonomic design - a rather convenient string-up are among the WINGS FDY PA6 concept's most convincing arguments. The enclosed draw unit ensures low spin finish emissions, offering a safe working environment.

Offering swift string-up, the optimized yarn path of the tried-and tested WINGS FDY PET system is united with the high relaxing performance of conventional polyamide systems to create a completely new concept. The 24-end WINGS FDY PA hence profitably combines the benefits of both processes. The result: outstanding yarn properties, excellent dyeability, optimum process performance and high fullpackagerate. A perfect package build guarantees excellent further processing properties in the downstream processes. With a 116-mm stroke, this winder makes high package weights possible, therefore delivering added-value yarns for further processing. As a consequence, yarn manufacturers can give themselves a competitive advantage in the marketplace.

The BCF S8 production plant promises carpet yarn manufacturers greater punching power within a fiercely contended market. Superlative spinning speeds, up to 700 filaments per yarn end, finer titers down to 2.5 dpf - the performance data and technological finesse of the new system already made an impression at its unveiling at the German DOMOTEX trade fair in January. At Shanghaitex 2019 the monochrome and the tricolor version of the BCF S8 was unveiled.
Polyester and its applications are omnipresent in our everyday lives. Whether as beverage bottles, filmpackaging, high-tech sports shirts or safety belts, polyester excels with its excellent mechanical properties and inexpensive production. However, the constantly rising demand requires responsible handling of global resources. For this reason, it is not only 'virgin polyester' generated from crude oil that is exclusively the raw material for manufacturing, so too is polyester recycled from post-production and postconsumer waste. Processing production waste also helps cut raw material, disposal and transport costs, and hence increasing efficiency.

With the new VacuFil® recycling series, Oerlikon Barmag in cooperation with its subsidiary company BB Engineering is offering a solution catering to a "clean technology" production philosophy. Decades of experience in the areas of extrusion, filtration and spinning systems have been bundled into a new, innovative core component - the vacuum filter. It unites gentle largescale filtration and controlled intrinsic-viscosity build-up for consistently outstanding melt quality. The vacuum unit - located adjacent to the filter - swiftly and reliably removes volatile contamination (spinning oil, etc.). The excellent degasification performance additionally relieves the energy-intensive predrying process.

The modular structure of the VacuFil® range offers numerous possibilities for the process guiding system. Whether as a standalone solution with downstream granulation or as an inline variant with 3DD additive feed - customer requirements can be optimally catered for with various system configurations.

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USTER®SENTINEL enables practical optimization for managers and shop floor personnel

Even in the best ring spinning mills, there is always room for improvements, among a complex range of options management and operatives need to consider for optimized productivity and profit. USTER®SENTINEL provides a fact-based overview of spinning machine performance, pinpointing real opportunities for excellence in the use of technology, components and manpower.
"The biggest challenge in my job is to source skilled shop floor operatives and retain them in the long run," says M. Kannan, General Manager responsible for technical and factory administration at Kikani Exports. The mill - obviously a well-run unit - is located at Dholka in the Indian state of Gujarat. Its installed

M Kannan, G.M., Kikani Exports

Ring spinning... as good as it can be
Capacity includes 29,376 ring spinning spindles and 4,320 twisting machine spindles. To improve the manpower situation, the mill prioritizes progressive HR policies and a decent working environment, as well as investing in sophisticated production machinery.

Wide-ranging benefits in ring spinning

"We invested in USTER® SENTINEL ring spinning optimization system with the goal to improve profits but we are delighted that staff also likes the installations," says Vrajesh Kikani, Managing Director, Kikani Exports. The mill reports a positive impact on profitability resulting from successful optimization of a number of factors, such as waste, ring traveler lifetime, machine speed and energy consumption etc.

Production focuses on 100% cotton combed compact yarns, in the count range Ne 20 to Ne 40, for weaving and knitting end-uses. The mill has been able to reduce waste by half since installing USTER® SENTINEL.

Enhanced overall productivity is a consequence of reducing pneumafil waste. USTER® SENTINEL also monitors the productivity of all spindles, feeding back all the required links and information to help yarn producers make optimization decisions at ring spinning based on reliable data.

Among potential problems for all spinners is inconsistent yarn quality characterized by low twist, caused by loose fibers blocking travelers—especially excessively worn ones. Only USTER® SENTINEL can identify spindles malfunctioning in this way, since the issue does not cause end-breaks but still produces yarns which are too weak for high-speed warping and weaving machines. Then unique Off-Standard feature of USTER® SENTINEL safeguards against 'hidden' quality risks such as this.

Bobbin build-up report gives practical support

End-break levels are a key indicator of ring spinning performance, and USTER® SENTINEL recognizes this by providing an intuitive bobbin build-up report for every parameter influencing end-breaks.

Spinners can then initiate improvements relative to their own mill, taking account of ambient conditions and energy consumption, as well as machine speed, wear of mechanical parts and personnel.

The bobbin build-up report also provides for higher performance, along with optimized cops. Comprehensive analysis of the speed curve - and its impact on quality throughout cop build-up - is a key element of the enhanced way of optimizing ring spinning performance. Cop build-up quality is the new dimension of optimization, enabling managers to select the correct machine settings for higher production yields, while keeping quality at the desired levels. Furthermore, it is now possible to compare ring spinning performance between different machines.

"The bobbin-build-up report offers us potential savings on travelers, optimizing their lifetime," says Kannan. He makes use of this facility for ring traveler performance comparisons by using the end-break information to indicate the end of traveler life cycles. The bobbin-built-up report allows the mill to monitor traveler wear related to age, checking stable end-break rates through the entire doff duration. This report shows the current state in intervals of five minutes, and an
overview provides information about end-breaks per 1,000 spindle-hours.

**Fact-based feel-good advantages**
Reports give status information at five-minute intervals, including end-breaks and piecings during that period. "Information about piecing speed helps me to identify each operator's skill level so that I can optimize the operation schedules and processes. Only by assigning manpower carefully it is possible to maintain ideal working conditions," says Kannan.

**USTER® SENTINEL** handles complete personnel management, including shift planning and staff assignment for all machines in the system - integrated with monitoring of critical ring spinning parameters. This makes personnel management in ring spinning fact-based and less time-consuming.

Reliable detection of slip, rogue and idle spindles is what makes **USTER® SENTINEL** popular among shop floor staff. LEDs indicate spindles showing an issue or positions where an end-break occurs, directing personnel quickly to fix the problem. Incidents are also shown on the machine display, providing an overview of spindles where attention is needed. "Operators really enjoy working thanks to **USTER® SENTINEL**, as it makes it easy to spot an end-break, even when patrolling far away. They enjoy the experience of handling their job efficiently and are under less stress - both of which increase the feel-good factor at work," says Kannan.

**The long view**
Optimizing the potential of ring spinning covers many aspects, taking advantage of **USTER® SENTINEL** and the data it provides: waste saving, compressed air saving, energy saving, cuts saved at winders and increased productivity and quality. Says Kikani: "**USTER® SENTINEL** works as a ring spinning optimization system, increasing profitability where it matters most… every day."

Kikani visited the USTER booth at ITMA 2019 in Barcelona. He was interested to learn about further technologies and how a mill will be managed in future. "I'm amazed about the advantages for ring spinning through connectivity. I can see more profit optimization potential. With **USTER® SENTINEL** and **USTER® QUANTUM** already installed, only **USTER® QUALITY EXPERT** is needed to correlate ring quality data and winding quality data in a single system."

There is one key performance indicator still not integrated the system but no less important to the company: "Enjoyment. A happy staff supports great performance and is a positive cost factor for the mill in the long run," says Kannan.

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**SDC International successfully conducted Conference at ITMACH 2019**

SDC International India Pvt. Ltd. in India successfully conducted an 'Engaging Color, Coloration & Compliance with the dyers and Colourists' conference at the ongoing ITMACH India 2019 exhibition during 05th to 07th December, 2019 in Gandhinagar, Gujarat. After the opening ceremony on 5th December 2019, Mr. Yogesh Gaikwad, Director of SDC International, introduced SDC, its mission and its objectives to the delegates.

1. The first presentation by Mr. Yogesh Gaikwad, Director of SDC International India Pvt. Ltd.
2. The second presentation by Mr. Uday Kale, Sr. Application Engineer of Datacolor Solutions Pvt. Ltd. Mumbai.
3. The third presentation by Mr. Sunil Malvankar, DGM in JAY Instruments & System Pvt. Ltd.

After the opening ceremony on 7th December 2019, Mr. Yogesh Gaikwad, Director of SDC International, introduced SDC, its mission and its objectives to the delegates. He welcomed the delegates, speakers & panelists to the seminar and gave introduction of the conference topic to all the guests followed by the lighting of the lamp by all the dignitaries. Chief Guest for the event, SDC CEO Dr. Graham Clayton, addressed the gathering of dyers, colourists and other textile value
chain stakeholders on the conference theme. He presented various initiatives from the SDC to engage with members and non-members.

He highlighted that unless associations adapt, they won't survive. The SDC two key strategic strands are key:

1) To develop a Colour Education Pathway spanning Further and Higher educational years, through employment and into retirement. This pathway will include Technical and Design communities worldwide and at all levels of qualification including the SDC Designer’s Coloration Certificate, the SDC Foundation & Textile Coloration Certificate and of course the flagship ASDC, and related LSDC, along with CCol Chartered status and FSDC, Fellowship of the SDC.

2) To develop SDC Communities to bring together like-minded individuals based on either geographical or interest commonalities. https://vimeo.com/225985648

This was followed by four technical sessions in which panel discussion were held. The first panel discussion on 'Compliance in Textile Manufacturing' was moderated by Mr. UllhasNimkar, Director of NIMKARTEX Technical services. The panelists comprised Dr. RumaChakrabarti, Business Head-India, Centexbel; Mr. Subhash Bhargava, Managing Director Colorant Ltd; Mr. SubaashDhananjayan, Managing Director for India & South Asia, The Sting, a Netherlands-based retail brand. In a very interactive session, Mr.Nimkar and the team of panelist highlighted the need to screen input chemicals like acids, salts for banned products too as in some cases heavy metals were found in salt. Textiles made of recycled material collected from the sea can also have chemicals that leached out due to prolonged exposure to sunlight.

The second panel discussion on 'Solutions to sustainable textile colouration' which was moderated by Mr. Anjani Prasad, Managing director and head brand performance textile specialities India, Nepal, Sri Lanka, Archroma India Pvt. Ltd. The panelists included Mr. Jayant Khera, Vice president South Asia, Dy Star India Pvt. Ltd; Mr. Siddharth Raj, Regional marketing manager-dyes responsibility, Huntsman International LLC; Dr. Binay Choudhary, Chairman, CU Inspection India Pvt. Ltd; and Yawar Ali Shah, Chairman and co-founder, AMA Herbal Laboratories Pvt. Ltd. It was a matter of concern raised by the panelist that a lot more needs to be done to a 'cleaner' colouration of textiles. Brands, Retailers and chemical manufacturers must collaborate and make collective contribution to sustainable textile colouration. Mr. Anjani Prasad and the panel gave various example were waste from one industry was used to created durable products in another.

Post lunch session on 'Brands response to call of sustainability' was moderated by Dr. Siva Pariti, Global technical program manager, Sustex Solutions. Mr. Sumit Gupta, Deputy Director, GOTS and Ms. Vandana Arora, Manager, Back Selling & CSI Liaising, DyStar India Pvt. Ltd, Mr. Ashok Sarda, Vice President Zydex Industries and Venkat Ramana Bhat, Regional Materials Manager were among the panelists. The panelist provided examples of sustainable initiatives by brands. Mr. Sarda highlighted the need for using pigments to reduce resources and create better managed colouration.

Mr. Sumit Gupta highlighted the success of brands and designers who have embraced organic pathway. Ms.Vandana put forward example of recycling by brands and that domestic brands must push much more towards attending a sustainable fashion brand. Mr.Bhat briefed about the precautions taken by Colombia during sourcing their raw materials for their products.

Environmental expert Dr. Jaideep Dudhbhate, consultant at Dr. JD Consulting, spoke on 'Best available technologies for wastewater management' in the last session.

All the sessions were very informative and interactive. Well appreciated by audience.

Vote of thanks was given by SDC CEO Dr. Graham Clayton with special thanks to all the dignitaries, Speakers, Moderators and panellist who contributed to sharing their knowledge to the esteemed audience. Also, a heartfelt thanks were given to the sponsors, M/s Archroma India Pvt. Ltd, M/s Kiri Industries Ltd, M/s AMA Herbal Laboratories Pvt. Ltd, M/s GOTS, ITMACH and ISFT for their contribution.

The SDC is the outstanding provider of colour education, offering a range of internationally recognised coloration courses and qualifications. Our mission is to educate the changing world in the science of colour. Founded in 1884, the SDC became a registered charity in 1962 and was awarded a Royal Charter in 1963. The SDC remains the only organisation in the world able to award the Chartered Colourist status. The SDC works globally, with worldwide membership and is a centre for networking and community engagement amongst the coloration industry.

More about SDC https://sdc.org.uk/
Successful trade fair appearance at the SINCE in Shanghai

Tailor-made solutions for hygiene, medical, filtration and other technical applications as well as extensive product and process know-how - with these arguments Oerlikon Nonwoven made a convincing appearance at the 18th Shanghai International Nonwoven Exhibition (SINCE) that took place from 11 to 13 December, 2019.

Dr. Ingo Mählmann, Head of Sales and Marketing of Oerlikon Nonwoven, was very pleased with the three lively days at the trade fair: "The many discussions showed that we are on the right track with our strategy and the further development of our technologies with regard to nonwovens. Visitors were impressed by our technology solutions for disposable nonwoven fabrics or geotextiles". Almost all well-known nonwoven fabric producers visited the trade fair stand of the plant manufacturer from Neumünster to find out about the advantages of spunbond, meltblown and airlaid technologies.

Overall, the nonwoven fabric team of the Oerlikon Group draws a very positive conclusion and looks back with satisfaction on the intensive and good quality discussions as well as numerous concrete inquiries from customers and prospective customers.

Extensive spunbond portfolio - always the right solution
In the field of spunbond technology, Oerlikon Nonwoven is already very broadly positioned. The production process for geotextiles made from polyester or polypropylene has been optimised. It is characterised by high production capacities and yields combined with low energy consumption.

For the production of hygiene nonwoven fabrics, Oerlikon Nonwoven offers its new QRS plant (Quality Sized Right). The webforming part of this plant is provided by Oerlikon's Chinese engineering partner and integrated into the overall plant. The advantage for the nonwoven fabric producer: competitive solutions at an attractive price level with comparatively low investments.

Melting technology for even higher qualities
With Oerlikon Nonwoven's optimized meltblown technology the production of new, unique and highly sophisticated filter media is made easy. Whether used as a stand-alone mono or bi-component plant, "plug & produce" installations in existing plants or in combination with other technologies: Oerlikon Nonwoven's meltblown process enables already today the cost-efficient production of meltblown nonwoven fabrics with tomorrow's quality requirements. More and more producers are opting for Oerlikon Nonwoven's meltblown solutions, which have proven their worth many times over and are subject to constant further development.

Airlaid technology for the nonwoven fabrics of tomorrow
The production of high-quality, lightweight airlaid nonwoven fabrics at economically attractive production speeds and plant throughputs is very much in demand today. In this area, Oerlikon Nonwoven sets new standards with its patented forming process characterised by homogeneous mixing of a wide range of raw materials while simultaneously achieving high uniformity and homogeneous fibre deposition even with very thin nonwoven fabrics. The advantages of this technology become increasingly important for sustainable applications in the recycling sector: Oerlikon Nonwoven successfully commissioned two airlaid recycling plants this year alone.

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TENCEL™ has announced its partnership with slow fashion label PAUSE to create a sustainable collection.

The collection titled ‘Ethical and Edgy’ brings together the perfect balance of utility and multifunctional clothing. Each ensemble has been created with the utmost care and an eye for detail, allowing it to be worn and styled in different ways. The structure of the garments highlights the features of TENCEL™ fibers, giving it a smooth, soft finish and fluid texture. This capsule collection features a range of deconstructed separates - jackets that convert to dresses, dresses which convert to tops, making fashion choices limitless. To elevate the sustainability quotient, the embellishments used in the collection are created from recirculated fabric and fabric scraps.

Commenting on the collaboration, Arpit Srivastava, Branding and Marketing, South Asia Lenzing Group said, "We at Lenzing are excited to have collaborated with PAUSE to create this capsule collection. With increase in consumer awareness on the ecological strain created by the fashion industry, sustainability is the need of the hour. PAUSE has helped us to reinforce the importance of ethical clothing and innovations driven to increase an interest among consumers towards sustainable fashion. The collection is trendy, while at the same time brings together the sustainability factor, redefining everyday fashion."

Speaking about the collection, Neha Modi & Neha Tham - Founders of PAUSE, "At Pause, comfort is our top priority. Therefore it was only natural for us to gravitate towards TENCEL™ fibers from the get go. Our mission is to create slow fashion but using rapid innovation and technology in our raw materials. Staying true to TENCEL™’s core competency- each garment is light and breathable along with a plethora of performance features and at the same time is high on sustainability. The silhouettes are feminine yet androgynous, structured but at the same time fluid allowing the customer to express themselves and to choose who they want to be."

Sustainable fashion has been conceived as a niche fashion category catering to a specific set of consumers. As a major misconception of such brands having higher prices for products and a limitation in clothing options to choose from, consumers tend to move towards fast fashion brands that are in sync with the trends and styles without burning a hole in the pocket. This association has helped build the idea that sustainable fashion can be trendy and contemporary.

TENCEL™ branded fibers are derived from sustainably managed forests and manufactured using an award-winning closed-loop process that produces fibers with a significantly lower carbon footprint and thus helps lower the ecological balance. With features like smoothness, breathability, colour retention and biodegradability, this is the perfect alternative option for both designers and consumers moving towards eco-fashion.

About PAUSE
Pause is a sustainable brand, that launched a little under 3 years ago, and since then the brand has gone from strength to strength. Pause began with pop-up stores across India - covering multiple cities in a short span of time. In September 2017, Pause opened their first store in Pali Hill, Bombay.

Housed in a two-storey bungalow, the store carries a complete ready-to-wear collection and plays host to a number of events and special launches. Pause focuses on using eco-friendly fabrics with minimal waste generation and has become the go to brand for many Indian celebrities like Kareena Kapoor & Malaika Arora Khan.
FORTHCOMING EVENTS

INDIA

EduTech India - International Exhibition & Conference on Education
Date : 09th to 11th January, 2020
Venue : Bombay Exhibition Centre, Goregaon (E), Mumbai
Contact : Mr. Tejinder Singh Nagi
Mob. : +91 9970159012
E-mail : tejinder.singh@nesco.in

Texcare Forum India - LaundrexNet, 2020
"Revolutionizing Laundry & Dry Cleaning Industry"
Date : 15th February, 2020
Venue : Bombay Exhibition Centre, Goregaon (E), Mumbai
Contact : Hardik Shah, Asst. Manager Sales Messe Frankfurt Trade Fairs India Pvt.Ltd.
Gala Impecca, 5th Floor, Andheri Kurla Road, Chakala, Andheri (E), Mumbai - 400093
Tel. : (+91) 22 61038425
Mobile : (+91) 8850 888 234
Email : hardik.shah@india.messefrankfurt.com
Website : www.messefrankfurt.com

The Textile Association (India) - Mumbai Unit organizing One Day Seminar "Opportunities for Textile Industry in Challenging Scenario"
Date : 29th February, 2020
Venue : Hotel Fortune Park Galaxy, Daffodil hall, GIDC, N.H. No. 08, Vapi- 396 195 (Gujarat)
Contact : Mr. Haresh B. Parekh, Conference Convener
The Textile Association (India) - Mumbai Unit
Amar Villa, Flat No. 3, Behind Villa Diana, 86, College Lane, Off Gokhale Road,
Near Maher Hall, Dadar (W), Mumbai - 400 028
Tel. : 022-24328044 / 24307702,
Fax : 022-24307708
E-mail : taimumbunit@gmail.com, 2taimu@mtnl.net.in
Website : www.textileassociationindia.com

9th Hometex Tech Expo
Date : 13th to 15th March, 2020
Venue : AnnaajMandi Complex, Panipat
Contact : Mr. rajesh Sinha / Mr. Manoj Arya Essential Events & Trade Fairs
Anmol Plaza, Plot no. 7, Sector 8, Kharghar, Navi Mumbai - 410 210
Mobile : 9324077881 / 9718514089
E-mail : info@essentialtradefairs.com, hometex@gmail.com
Website : www.essentialtradefairs.com

IND-TEXPO 2020
Date : 17th to 19th March, 2020
Venue : CODISSIA Centre, Coimbatore
Contact : The Cotton Textiles Export Promotion Council (TEXPROCIL)
Engineering Centre, 5th Floor, 9 Mathew Road, Mumbai 400 004, INDIA
Tel. : (+91)(22) 49444000, Fax: (+91)(22)23632914
E-mail : events@ind-tespo.com
Website : www.texprocil.org

7th Non Woven Tech Asia 2020
Date : 05th to 06th June, 2020
Venue : PragatiMaidan, New Delhi, India
Contact : Radeecal Communications
402, 4th Floor, "Optionz" Complex, Opp. IDFC Bank, Between Girish Coldrink and Xaviers Corner, Off C.G Road, Navrangpura, Ahmedabad- 380009Guj
Mobile : +91 91734 40725
E-mail : sales@nonwoventechasia.com

ABROAD

International Textile & Textile Engineering Exhibition (ITME AFRICA)
Date : 14th to 16th February, 2020
Venue : Millenium Hall, Addis Ababa, Ethiopia
Contact : India ITME Society
1210/1211, Dalamal Tower, A wing, 12th Floor, Plot No. 211, Nariman Point, Mumbai- 400 021
Tel. : 40020233, 22020032, 6630 3834
Fax : 022-2225 1578, Mobile: 7303456667
E-mail : itme@india-itme.com, itme@itme-africa.com
Website : itme-africa.com

Every effort is made to ensure that the information given is correct. You are however, advised to re-check the dates with the organizers, for any change in schedule, venue etc., before finalizing your travel plans.
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