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Hope you all, your family & all your loved ones are fine & healthy.

The Covid-19 pandemic has caused widespread disruption to organisations large and small, across the globe. The textiles and clothing industry has been no exception to the pandemic shocks, leaving each of us crystal gazing and reimagining what the business ecosystem would look like in the era of social distancing, masks and sanitizers. The Indian textile industry was already struggling in the recent past due to the glut in the market conditions and the further impact of COVID-19 has made Textile & Clothing (T&C) industry to incur huge losses and face severe financial stress. The international and domestic demand for textiles and clothing is likely to drop by 30% to 50% and therefore, the recession will continue for some more time.

COVID-19 is also presently a mammoth negative event for India & Indian Economy and it will definitely generate equally strong opposite positive reactions that would bring long lasting changes never imagined hitherto. In this context, there is a list of few tangibles & intangibles that had already happened in response to COVID 19 along with the way we should react positively to build on. You will also find that COVID-19 can also actually be seen as a Change Accelerator. In that sense, Corona has already achieved change in the systems in the last few days what the Government could not do in many years.

Overnight the paradigm shift has happened. India strive for high end digital infrastructure which resulted in digital economy activation. COVID-19 lockdowns imposed digital payment/ transactions on everyone. WFH can be a second COVID-19 gift to India’s prosperity. So far WFH was sparingly used as a retention/luring perk by few select large corporations but Corona in an overnight made "Work from Home" a new Normal. We also came across this information that many companies are planning to shift part of their manufacturing base to India Now Corona has fuelled the hate for China, no doubt subject to readiness of facilities & willingness of our Government & us.
It is also well understood that we should not be dependent on one source of supply. Message of Hon. Prime Minister is strongly conveyed nationally to make 'AATMANIRBHAR BHARAT'. Let us all work together in our own capacity to achieve this. Textile Industry have already set example for the same in case of PPE Kits & Mask looking to the need of the Nation.

No doubt, COVID -19 have impacted on our daily life & system. We are forced to avoid physical meeting, travelling etc. may be for the time being. Accordingly at TAI, we also adopted to have webinar instead of seminars. TAI - Central Office & Units like South India & Mumbai have already organised series of webinar on various topics. It was well attended & well received by members. Recording link of all the webinars are uploaded on our website for the benefits of the members, who couldn't attend due to any reason.

Due to lockdown situation in Mumbai, all establishments are closed& same is our TAI Office. Due to closure of printing press, although we couldn't get printed our issues of JTA but "e" issues of JTA is being sent to all members in spite of all adverse conditions.

Let us all hope to get the situation normal at the earliest possible.

Stay Safe, Stay Healthy. God Bless All!

Ashok Juneja  
President  
The Textile Association (India)
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Jute Fibre Gradation by Hybrid AHP-TOPSIS Methodology of Multi-Criteria Decision Making Technique

Dr. Ashis Mitra
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Abstract
Amongst the various exponents of Multi-Criteria Decision Making (MCDM) techniques, the hybrid AHP-TOPSIS approach is much more robust-yet-flexible paradigm in any case of decision-making problem. This methodology is based on strong mathematical foundation of both AHP (Analytic Hierarchy Process) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solutions). Gradation of jute fibres on the basis of certain quantitative as well as subjective parameters or attributes is done by traditional method which follows the Bureau of Indian Standards (BIS) gradation system. In this paper a modified approach has been proposed using hybrid AHP-TOPSIS tool for ranking/gradation and thereby selection of jute fibres on the basis of some apposite selection criteria like fibre strength, root content, fibre defects, fibre colour, bulk density and fibre fineness. It is found that the orders of preference of the top-ranked and worst-ranked jute fibre varieties/samples exactly match with the traditional BIS system and MAHP approach done by an earlier researcher. Moreover, the new hybrid approach shows an overall good agreement in terms of ranking with the previous system or approach.

Keywords
AHP, Jute Gradation, MCDM, TOPSIS.

1. Introduction
The experiences of the domain experts play an important role during the gradation of jute fibres. In some cases, it is done using BIS method [1-2]. In BIS method, which is a scientific grading system introduced by Bureau of Indian Standards in 1969, eight grades are used to be identified initially based on seven jute fibre parameters. However, in the modern BIS jute grading system, eight jute grades are identified on the basis of only six physical parameters or attributes of jute fibres namely strength (tenacity), root content, defects, fineness, colour and (bulk) density. In the present BIS system, jute gradation is primarily done using a scoring system of the above mentioned six fibre parameters, and this is done as per IS: 271 - 2003 standard where different score marks has been stipulated for each grade [1]. Choudhuri [2] considered above mentioned six jute fibre parameters as six decision criteria and presented an alternative approach for jute fibre gradation or ranking with the help of Multiplicative Analytic Hierarchy Process (MAHP).

Amongst the various exponents of MCDM technique, the AHP is one of the widely used and most talked about approach which can efficiently handle both the tangible and the intangible attributes. According to AHP method, in a decision-making problem with M alternatives and N criteria, the total number of pair-wise comparison matrices is expressed by the following expression :

\[
\frac{N(N-1)}{2} + \frac{M(M-1)}{2}
\]

which may be practically unmanageable in situations where a large number of decision criteria and alternatives are involved.

TOPSIS, on the contrary, is more efficient in handling the tangible attributes and there is no limitation of the number of decision criteria or alternatives. Hence, in this paper, a maidenendeavour has been made using...
AHP-TOPSIS hybrid method/approach for solving the same problem (i.e. gradation and selection of jute fibres) using the same data set employed by Choudhuri [2], and the efficacy of the proposed method has been evaluated with respect to the earlier methods/approaches using Spearman’s rank correlation coefficient.

2. AHP-TOPSIS Hybrid Methodology

The AHP was invented by T.L. Saaty [3-8], and it is based on the formation of pair-wise comparison matrix to extract relative weights of criteria and scores of alternatives. The TOPSIS was developed by Hwang and Yoon [9], the basic philosophy of which is that the selected alternative/option should have the shortest distance, in a geometrical sense, from the positive ideal solution (PIS) and longest distance from the negative ideal solution (NIS) or worst solution. In the case of AHP-TOPSIS hybrid approach, on the other hand, the pair-wise comparison method of AHP is amalgamated with the other steps of TOPSIS. The below is explained the fundamental steps involved in the AHP-TOPSIS hybrid approach [10]:

**Step 1 :**
The relevant goal or objective, the decision criteria and the alternatives of the problem are identified.

**Step 2 :**
A decision matrix of criteria and alternatives are produced, in this step, basis the information available regarding the problem in hand. If number of alternatives is M and number of criteria is N, then the resultant decision matrix with an order of M x N can be represented as under:

\[
D (M\times N ) = \begin{bmatrix}
x_{11} & x_{12} & \cdots & x_{1N} \\
x_{21} & x_{22} & \cdots & x_{2M} \\
\vdots & \vdots & \ddots & \vdots \\
x_{M1} & x_{M2} & \cdots & x_{MN}
\end{bmatrix}
\]

where the element \( x_{ij} \) denotes the actual value of \( j^{th} \) alternative w.r.t. \( i^{th} \) decision attribute.

<table>
<thead>
<tr>
<th>Intensity of importance</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
<td>Two activities contribute equally to the objective.</td>
</tr>
<tr>
<td>3</td>
<td>Moderate importance</td>
<td>Experience and judgement slightly favour one activity over another.</td>
</tr>
<tr>
<td>5</td>
<td>Essential or strong importance</td>
<td>Experience and judgement strongly favour one activity over another.</td>
</tr>
<tr>
<td>7</td>
<td>Very strong importance</td>
<td>An activity is very strongly favoured and its dominance is demonstrated.</td>
</tr>
<tr>
<td>9</td>
<td>Extreme importance</td>
<td>The evidence favouring one activity over another is of the highest possible order of affirmation.</td>
</tr>
<tr>
<td>2, 4, 6, 8</td>
<td>Intermediate values between two adjacent judgement</td>
<td>When compromise is needed.</td>
</tr>
<tr>
<td>Reciprocals</td>
<td>If activity p has one of the above numbers assigned to it when compared with activity q, then q has the reciprocal value when compared with p.</td>
<td></td>
</tr>
</tbody>
</table>
Step 3:
In this step, the decision matrix is converted to a normalized decision matrix so that the scores obtained in different scales become comparable. An element \( R_{ij} \) of the normalized decision matrix is calculated by Eq. (1):

\[
R_{ij} = \frac{x_{ij}}{\left[ \sum_{i=1}^{M} x_{ij} \right]^{1/2}}
\]

Step 4:
In this step, the relative importance of different criteria with respect to the objective of the problem and the scores of alternatives with respect to each of the criteria is determined by using a 9-Point scale of relative importance proposed by Saaty, which is shown in Table 2.1. For \( N \) criteria the size of the comparison matrix \( (P1) \) will be \( N \times N \) and the entry \( c_{ij} \) will denote the relative importance of criterion \( i \) with respect to the criterion \( j \). In the matrix,

\[
c_{ij} = 1, \text{ for } i=j \text{ and } c_{ij} = \cdots \text{ for } i \neq j.
\]

The pair-wise comparison matrix can be represented as follows:

\[
P_1 = \begin{bmatrix}
1 & c_{12} & \cdots & c_{1N} \\
c_{21} & 1 & \cdots & c_{2N} \\
\vdots & \vdots & \ddots & \vdots \\
c_{N1} & c_{N2} & \cdots & 1
\end{bmatrix}
\]

The relative weight or importance of the \( i \)th criteria \( (W_i) \) is determined by calculating the geometric mean \( (GM_i) \) of the \( i \)th row and then normalizing the geometric means of rows of the above matrix. This can be represented by the Eq. (2) and Eq. (3):

\[
GM_i = \left[ \prod_{j=1}^{N} c_{ij} \right]^{1/N}
\]

and

\[
W_i = \frac{GM_i}{\sum_{i=1}^{N} GM_i}
\]

Then matrix \( P_3 \) and \( P_4 \) are calculated such that \( P_3 = P_j \times P_2 \) and \( P_4 = P_1 / P_2 \), where \( P_2 = \left[ W_j \ W_2 \ \cdots \ W_N \right]^{T} \).

In order to check the consistency or validity of pair-wise comparison, at first the principal Eigen Vector \( (\lambda_{max}) \) of the original pairwise comparison matrix \( P1 \) is derived from the average of matrix \( P_j \). Afterwards, consistency index \( (I_c) \) and consistency ratio \( (R_c) \) are determined using Eq. (4) and Eq. (5), respectively:

\[
I_c = \frac{\lambda_{max} - N}{N-1}
\]

and

\[
R_c = \frac{I_c}{RCI}
\]

where \( RCI \) is random consistency index whose values are given in Table 2.2. The judgement is considered to be consistent and hence acceptable only if the value of \( R_c \) is less than or equal to 0.1. Otherwise, the pair-wise comparison matrix has to be reconstructed by reconsidering the entries of the matrix.

Step 5:
The weighted normalized matrix is obtained by multiplying each column of the normalized decision matrix \( R \) by the associated criteria weight corresponding to that column. Hence, an element \( v_{ij} \) of weighted normalized matrix \( V \) can be represented by Eq. (6):

\[
v_{ij} = W_j \times R_{ij}
\]

Step 6:
In this step, the positive ideal solution \( (A^+) \) and negative ideal solution \( (A^-) \) are generated in the following manner:

\[
A^+ = \{ (\max v_{ij} / j \in J), (\min v_{ij} / j \in J') \text{ for } i = 1,2,3, \ldots, M \} = \{v_1^*, v_2^*, \ldots, v_N^* \}
\]

\[
A^- = \{ (\min v_{ij} / j \in J), (\max v_{ij} / j \in J') \text{ for } i = 1,2,3, \ldots, M \} = \{v_1^-, v_2^-, \ldots, v_N^- \}
\]

where \( J = \{ j = 1,2,3, \ldots, N / j \text{ associated with benefit or positive criteria} \} \)

and \( J' = \{ j = 1,2,3, \ldots, N / j \text{ associated with cost or negative criteria} \} \)
For the benefit criteria (higher-the-better type), the decision maker wants to have the maximum value among the alternatives. So, $A^*$ indicates the positive ideal solution (PIS). On the contrary, for the cost criteria (lower-the-better type), the decision maker wants to have the minimum value amongst the alternatives, and hence, $A^-$ indicates the negative ideal solution (NIS).

**Step 7**

The N dimensional Euclidean distance method is applied in this case, to measure the separation distances of each alternative from PIS and NIS.

$$D_i^* = \left\{ \sum_{j=1}^{N} (v_{ij} - v_{ij}^{*})^2 \right\}^{1/2}, \quad i = 1, 2, ..., M$$

and

$$D_i^- = \left\{ \sum_{j=1}^{N} (v_{ij} - v_{ij}^{-})^2 \right\}^{1/2}, \quad i = 1, 2, ..., M$$

where $D_i^*$ and $D_i^-$ are the separation distances of alternative $i$ from the PIS and NIS, respectively.

**Step 8**

In this step, the relative closeness or degree of closeness ($C_i^*$) of each alternative with respect to PIS is derived using Eq. (7). Noteworthy to mention, here, that the value of $C_i^*$ ranges from 0 to 1.

$$C_i^* = \frac{D_i^-}{D_i^* + D_i^-}$$

---

### 3. Materials and Methods

#### 3.1. Data Collection and Analysis

The test results of nine jute fibre varieties or samples with respect to six fibre parameters like bundle strength (tenacity), root content, defects, fibre fineness, fibre colour and bulk density, as well as fibre gradation as per existing BIS grading system have been collected from National Institute of Research on Jute and Allied Fibre Technology (NIRJAFT) and furnished in Table 3. As mentioned earlier, the same data set were used by Choudhuri [2] for his gradation approach through MAHP.

In BIS gradation system, attributes like fibre colour and bulk density are assessed subjectively. However, in order to facilitate numerical calculations, these subjective attributes or criteria should be assigned numerical values. The same assignment conversion as employed by Choudhuri [2] in his approach, is adopted in this case also to keep parity in the original data set. Hence, the 'Fair good' and 'Fair average' colour attributes have been assigned numerical values 3 and 2 respectively, and two density attributes namely 'Medium bodied' and 'Heavy bodied' have been assigned values 2 and 3 respectively, as shown within small brackets along with corresponding attributes in Table 3.1.

#### Table 3.1: Original data set containing jute fibre properties and BIS gradation [2]

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Tenacity (g/tex)</th>
<th>Root content(%)</th>
<th>Defects (%)</th>
<th>Fineness (tex)</th>
<th>Colour</th>
<th>Density</th>
<th>BIS Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24.2</td>
<td>10</td>
<td>1.5</td>
<td>2.9</td>
<td>Fair good (3)</td>
<td>Medium bodied (2)</td>
<td>TD-4 + 60%↑</td>
</tr>
<tr>
<td>2</td>
<td>26.5</td>
<td>8</td>
<td>1.5</td>
<td>3.2</td>
<td>Fair good (3)</td>
<td>Medium bodied (2)</td>
<td>TD-4 + 80%↑</td>
</tr>
<tr>
<td>3</td>
<td>23.1</td>
<td>8</td>
<td>1.5</td>
<td>3.0</td>
<td>Fair good (3)</td>
<td>Medium bodied (2)</td>
<td>TD-4 + 65%↑</td>
</tr>
<tr>
<td>4</td>
<td>24.1</td>
<td>8</td>
<td>2.0</td>
<td>3.3</td>
<td>Fair good (3)</td>
<td>Medium bodied (2)</td>
<td>TD-4 + 20%↑</td>
</tr>
<tr>
<td>5</td>
<td>27.1</td>
<td>8</td>
<td>2.0</td>
<td>2.9</td>
<td>Fair average (2)</td>
<td>Medium bodied (2)</td>
<td>TD-4 + 35%↑</td>
</tr>
<tr>
<td>6</td>
<td>21.0</td>
<td>15</td>
<td>1.5</td>
<td>3.0</td>
<td>Fair average (2)</td>
<td>Medium bodied (2)</td>
<td>TD-4</td>
</tr>
<tr>
<td>7</td>
<td>18.8</td>
<td>10</td>
<td>2.0</td>
<td>3.5</td>
<td>Fair average (2)</td>
<td>Medium bodied (2)</td>
<td>TD-5 + 20%↑</td>
</tr>
<tr>
<td>8</td>
<td>22.4</td>
<td>15</td>
<td>2.0</td>
<td>3.1</td>
<td>Fair average (2)</td>
<td>Medium bodied (2)</td>
<td>TD-5 + 60%↑</td>
</tr>
<tr>
<td>9</td>
<td>15.5</td>
<td>15</td>
<td>1.0</td>
<td>2.6</td>
<td>Fair average (2)</td>
<td>Heavy bodied (3)</td>
<td>TD-5 + 80%↑</td>
</tr>
</tbody>
</table>
3.2 AHP-TOPSIS Approach for Jute Fibre Gradation

It has been already observed that the problem of jute fibre gradation and selection in order to determine the quality value of different jute fibre varieties can be formulated as an MCDM problem as envisaged by Choudhuri [2]. In this paper, the same jute fibre gradation problem has been considered, which consists of nine jute fibre varieties/samples to be evaluated (using hybrid AHP-TOPSIS approach) with respect to six jute fibre criteria or parameters, namely bundle strength (BS), fibre defects (FD), root content (RC), fibre fineness (FF), fibre colour (FC), and bulk density (BD). The data set for developing the related decision matrix for this gradation problem are shown in Table 3 which also shows the gradation as per existing BIS system. It is obviously a challenging decision making problem since the values of the criteria or parameters under consideration are not only quite close to each other but conflicting, too. These values of jute fibre properties (or criteria) have been employed to derive the quality index ($C_{i}^{*}$) of individual jute fibre variety/sample using hybrid AHP-TOPSIS approach.

In order to determine the quality indices/values of different jute fibre varieties, which is the goal of the present decision making situation, the same type of hierarchy formulation as proposed by Choudhuri [2] is adopted here also, as shown in Figure 3.1.

### Table 3.2: Pair-wise comparison matrix and global weights of criteria w.r.t. goal

<table>
<thead>
<tr>
<th>Criteria</th>
<th>BS</th>
<th>FC</th>
<th>BD</th>
<th>RC</th>
<th>FD</th>
<th>FF</th>
<th>Geometric Mean (GM) of Criteria</th>
<th>Normalized GM [global weights]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>1</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>4.1407</td>
<td>0.4809</td>
</tr>
<tr>
<td>FC</td>
<td>1/8</td>
<td>1</td>
<td>1/2</td>
<td>1/3</td>
<td>1/4</td>
<td>1/3</td>
<td>0.4368</td>
<td>0.0507</td>
</tr>
<tr>
<td>BD</td>
<td>1/6</td>
<td>1/2</td>
<td>1</td>
<td>1/2</td>
<td>1/4</td>
<td>1/2</td>
<td>0.4163</td>
<td>0.0484</td>
</tr>
<tr>
<td>RC</td>
<td>1/7</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1/4</td>
<td>1/2</td>
<td>0.6892</td>
<td>0.0800</td>
</tr>
<tr>
<td>D</td>
<td>1/5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1.9270</td>
<td>0.2238</td>
</tr>
<tr>
<td>FF</td>
<td>1/3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1/4</td>
<td>1</td>
<td>1.0000</td>
<td>0.1161</td>
</tr>
</tbody>
</table>

### 3.3 Determining criteria weights or priority weights

The pair-wise comparison matrix of the six decision criteria with regard to overall goal of the problem is presented in Table 3.2. The pair-wise comparison amongst different criteria has been done on the basis of Saaty’s 9-Point Relational Scale presented in Table 2.1.

While making pair-wise comparison, the parameter bundle strength (BS) has been assigned moderate importance over fibre fineness (FF), essential/strong importance over fibre defects (FD), and very strong importance over root content (RC). Moreover, the relative importance of parameter ‘BS’ over bulk density (BD) is between strong and very strong, and that over criterion fibre colour (FC) is between very strong and extreme. The other pair-wise comparisons have been made, likewise.
Since, the consistency ratio \( (R_c) \) is well below 0.1, so the judgement of the pair-wise comparison is consistent and hence acceptable. The values of normalized \( GMs \) represent the relative importance of the criteria with respect to the overall objective, and since there is no sub-criterion of any of the main criterion, the relative importances of the considered criteria indicate their global weights with respect to the objective. Therefore, the global weights of strength \( (BS) \), colour \( (FC) \), density \( (BD) \), root content \( (RC) \), defects \( (D) \) and fineness \( (FF) \) are 0.4809, 0.0507, 0.0484, 0.0800, 0.2238, and 0.1161 respectively. It should be noted here that \( BS, FC \) and \( BD \) are all benefit criteria (higher-the-better type) since they do exert a positive influence on the overall goal, whereas \( RC, D \) and \( FF \) are cost criteria (lower-the-better type) having a negative influence on the overall goal.

### Table 4.1: Normalized decision matrix of criteria

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>BS</th>
<th>FC</th>
<th>BD</th>
<th>RC</th>
<th>D</th>
<th>FF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.3540</td>
<td>0.4009</td>
<td>0.3123</td>
<td>0.3153</td>
<td>0.2942</td>
<td>0.3153</td>
</tr>
<tr>
<td>2</td>
<td>0.3877</td>
<td>0.4009</td>
<td>0.3123</td>
<td>0.2522</td>
<td>0.2942</td>
<td>0.3480</td>
</tr>
<tr>
<td>3</td>
<td>0.3379</td>
<td>0.4009</td>
<td>0.3123</td>
<td>0.2522</td>
<td>0.2942</td>
<td>0.3262</td>
</tr>
<tr>
<td>4</td>
<td>0.3525</td>
<td>0.4009</td>
<td>0.3123</td>
<td>0.2522</td>
<td>0.3922</td>
<td>0.3588</td>
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<tr>
<td>5</td>
<td>0.3964</td>
<td>0.2673</td>
<td>0.3123</td>
<td>0.2522</td>
<td>0.3922</td>
<td>0.3153</td>
</tr>
<tr>
<td>6</td>
<td>0.3072</td>
<td>0.2673</td>
<td>0.3123</td>
<td>0.2522</td>
<td>0.3922</td>
<td>0.3262</td>
</tr>
<tr>
<td>7</td>
<td>0.2750</td>
<td>0.2673</td>
<td>0.3123</td>
<td>0.3153</td>
<td>0.3922</td>
<td>0.3806</td>
</tr>
<tr>
<td>8</td>
<td>0.2267</td>
<td>0.2673</td>
<td>0.4685</td>
<td>0.4729</td>
<td>0.1961</td>
<td>0.2827</td>
</tr>
</tbody>
</table>

4. Results and Discussion

Once the global weights or priority weights of different criteria with respect to the objective of the problem were determined as shown in Table 3.2, the other steps of AHP-TOPSIS method were followed as chalked out earlier (from Step 5 to Step 9) for calculating quality index of jute fibre varieties (alternatives).

### Table 4.2: Salient results of AHP-TOPSIS alongwithquality index \( (Ci^*) \) and ranking of alternatives

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Weighted Decision Matrix of Criteria</th>
<th>( Di^* )</th>
<th>( D_i^- )</th>
<th>( Ci^* )</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1702 0.0203 0.0151 0.0252 0.0658 0.0366</td>
<td>0.0315</td>
<td>0.0670</td>
<td>0.6800</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>0.1864 0.0203 0.0151 0.0202 0.0658 0.0404</td>
<td>0.0248</td>
<td>0.0827</td>
<td>0.7695</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0.1625 0.0203 0.0151 0.0202 0.0658 0.0379</td>
<td>0.0368</td>
<td>0.0611</td>
<td>0.6241</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>0.1695 0.0203 0.0151 0.0202 0.0878 0.0417</td>
<td>0.0501</td>
<td>0.0634</td>
<td>0.5589</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>0.1906 0.0136 0.0151 0.0202 0.0878 0.0366</td>
<td>0.0452</td>
<td>0.0838</td>
<td>0.6497</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>0.1477 0.0136 0.0151 0.0379 0.0658 0.0379</td>
<td>0.0526</td>
<td>0.0449</td>
<td>0.4608</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>0.1323 0.0136 0.0151 0.0252 0.0878 0.0442</td>
<td>0.0748</td>
<td>0.0264</td>
<td>0.2611</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>0.1576 0.0136 0.0151 0.0252 0.0878 0.0392</td>
<td>0.0565</td>
<td>0.0504</td>
<td>0.4717</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>0.1090 0.0136 0.0227 0.0379 0.0439 0.0328</td>
<td>0.0838</td>
<td>0.0460</td>
<td>0.3543</td>
<td>8</td>
</tr>
</tbody>
</table>

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The determination of normalized decision matrix (as shown in Table 4.1) and weighted normalized decision matrix were done in accordance with the method described earlier. After the determination of positive ideal solution (PIS) and negative ideal solution (NIS) corresponding to each criterion, the separation distances of alternatives from the PIS \((D_i^+)\) and that from the NIS \((D_i^-)\) were calculated. Table 4.2 reveals the salient results of AHP-TOPSIS analysis. The values of relative closeness indeces \((C_i^*)\) for 9 jute fibre alternatives are depicted in Figure 4.1. It is observed that the best alternative is sample no 2 with a \(C_i^*\) value of 0.7695 being close to 1, whereas the worst choice is jute fibre sample no 7 with a \(C_i^*\) value of 0.2611 which is close to zero.

![Figure 4.1: Relative closeness values (or quality indices) of jute fibres](image)

The comparison of ranking orders obtained by earlier methods and the proposed AHP-TOPSIS-based approach is furnished in Table 4.3.

### Table 4.3: Comparison of ranking orders of different models

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>BIS ranking</th>
<th>MAHP ranking [2]</th>
<th>AHP-[2]TOPSIS ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
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<td>7</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>9</td>
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</tr>
<tr>
<td>8</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

It is found from Table 4.3 that, for all the three approaches or ranking methods, jute fibre samples 2 and 7 occupy the same position in the ranking patterns — rank 1 (best choice) and rank 9 (worst choice), respectively. There are slight discrepancies, however, in some of the intermediate rankings. The possible cause of these discrepancies may be attributed to the different approaches of ranking the alternatives in two methods. Nevertheless, it has been found that the differences/discrepancies in ranking patterns of the two methods (BIS and AHP-TOPSIS) are not statistically significant (vide Appendix I for statistical analysis).

### Table 4.4: Comparison of different methods using Spearman’s rank correlation coefficients

<table>
<thead>
<tr>
<th>Method</th>
<th>BIS Grading System</th>
<th>MAHP</th>
<th>AHP-TOPSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS Grading System</td>
<td>-</td>
<td>0.9333</td>
<td>0.9000</td>
</tr>
<tr>
<td>MAHP</td>
<td>-</td>
<td>0.9333</td>
<td>-</td>
</tr>
<tr>
<td>AHP-TOPSIS</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

In order to check the validity and efficacy of the proposed decision making model, a comparison of ranking performances obtained by earlier methods and that attained by the proposed model is presented in Table 4.4, on the basis of Spearman’s Rank Correlation analysis which is given by Eq. (8):

\[
R_s = 1 - \frac{6\sum_{i=1}^{M} D_i^2}{M(M^2-1)}
\]

where \(R_s\) is Spearman’s rank correlation coefficient, \(D_i\) is absolute difference between rankings obtained by any two methods, and \(M\) is the total number of decision alternatives, which is 9 in this case.

Very high Spearman’s rank correlation coefficients of 0.9000 between existing BIS system and AHP-TOPSIS-based ranking, and that of 0.9333 between MAHP ranking done by Choudhuri [2] and the proposed AHP-TOPSIS model corroborates the potential applicability of the proposed model in gradation and ranking of the candidate jute fibre samples (varieties) thereby identifying the choice for specific end-use requirements.

It is worth mentioning at this juncture that the entire analysis has been performed using MCDM Plus, a self-developed user-friendly software developed using MATLAB2015 programming platform.
5. Conclusion
A new approach of MCDM technique has been demonstrated to evaluate the quality index of jute fibre varieties, thereby ranking and grading the candidate jute fibres in terms of applicability towards specific end-use. All the jute fibre properties or attributes were given commensurate weights based on their influence on overall objective. The final ranking of 9 jute fibre varieties was elicited by the proposed approach which amalgamates the principles of two popular exponents of MCDM, namely AHP and TOPSIS. The ranking or gradation of jute fibres attained by this hybrid method corroborates a very good degree of agreement with existing BIS gradation system and MAHP approach done by an earlier researcher. Free from ranking inconsistencies (associated with AHP method alone), the AHP-TOPSIS hybrid approach exploits the experience of the domain experts to construct the pairwise comparison matrix, which can be modified very easily in new situation. Thus, the new approach is a flexible-yet-potent way of decision-making and can be applied in any such situation regardless of fibre types.

Appendix I
Statistical F-Test Analysis to Compare Rankings of BIS and AHP-TOPSIS Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Variance in rankings (σ²)</th>
<th>Sample size (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS Method</td>
<td>variance in rankings (σ²) = 7.5</td>
<td>n₁ = 9</td>
</tr>
<tr>
<td>AHP-TOPSIS Method</td>
<td>variance in rankings (σ²) = 7.5</td>
<td>n₂ = 9</td>
</tr>
</tbody>
</table>

Step-1 : Stating the Hypotheses
Null hypothesis (H₀) : difference in ranking patterns not statistically significant.

Alternative hypothesis (H₁) : difference in ranking patterns statistically significant.

Step-2 : Finding the Calculated F Value

\[ F_{\text{calculated}} = \frac{7.5}{7.5} = 1 \]

Step-3: Calculation of Degrees of Freedom (df)

Degrees of freedom for BIS method (df₁) = n₁ − 1 = 8

Degrees of freedom for AHP-TOPSIS method (df₂) = n₂ − 1 = 8

Step-4 : Selection of the Level of Significance (α-level)
Let us choose the standard level of 0.05.

Step-5 : Finding the Critical F Value from the F-Table
For df₁ = df₂ = 8, with α = 0.05, the critical F value can be found as:

\[ F_{8,8,0.05} = 3.44 \]

Step-6: Statistical Inference Through Comparison of F Values
Since, \[ F_{\text{calculated}} \leq F_{\text{critical}} \]
so, we cannot reject the null hypothesis (H₀), i.e. H₀ is true.

In other words, there is enough evidence (with 95% confidence) that the difference in ranking patterns (given by BIS and AHP-TOPSIS methods) are not statistically significant.

References
Impact of Celebrity Endorsements on Textile Brands: A Study of Indian Innerwear Industry

Dr. K. P. Sandhya Rao & Prof. Shilpa Praveen
Justice K S Hegde Institute of Management, Nitte

Abstract
Celebrities are the star personalities who can influence the success of a brand successfully. Their style is imitated, copied easily by masses who devour their moment to connect with a product or service that the celebrity presumably uses as he/she endorses it. As a result, many brands today associate themselves with a celebrity who can showcase their brands in advertisements and create an image that a brand desires.

This study is an attempt to quantitatively measure the impact that celebrity endorsements have on the choice of inner wear brands for an urban population. India has several national brands of men's innerwear endorsed by celebrities along with global brands that have a stronger presence and affordable products than ever before.

The objective of this study is to find if celebrities have an impact on consumers' purchase intentions for products such as men's innerwear. Primarily, the study intends to find whether the brand name of the innerwear or the celebrity endorsing the brand has more impact on customers. The study included a survey, and data was analyzed through statistical tools such as frequency distribution and cross-tabulation through SPSS. The findings show that the respondents purchased a particular brand because of the quality and brand image and celebrities don't have much impact on buying of innerwear especially with older customers. The consumers of 19-25 years age group have a slightly higher impact on celebrity endorsements. As this age group is more active in social media and recall rate of advertisements is slightly higher compared to other age groups. Many responses were of a view that premium brands of innerwear need not have a celebrity to influence customers to purchase as it is well-established in their minds.

Keywords
Celebrity Endorsement, Advertisements, Purchase Intention, Brand Preference

1. Introduction
In the current times, well-designed marketing strategies of a company play an important role in the success of its products. There are several marketing strategies that companies adopt to promote their products. Celebrity endorsement is one such strategy that most companies use to reach out to their customers. The fame, image, and trust celebrities develop in their respective fields will be transferred to the endorsed product or brand. Celebrities have a great fan following and are very popular; hence, they can have a great impact on the sale of a product. Celebrities are endorsing different products such as perfumes, laundry detergents, soaps, personal care products including hair care and skin care, cosmetics, soft drinks, chocolates, sneakers, cars, etc. to name a few. Celebrities like Bollywood actors, cricketers, athletes and professional models have signed contracts with several companies for endorsing their brands for a certain fee. The main purpose of an endorsement strategy is to create an emotional attachment between the endorser and the consumer to increase product and brand awareness and improve the image of the company [1]. The strategy has been very effective, and several brands have been successful in garnering attention from their customers through the use of celebrities.

The objective of this study is to find whether the celebrities have an impact on the consumers in their purchase intention of inner wears. Several companies are heavily using celebrity endorsement strategies for different product categories. The main objective of any ad is to create awareness and interest in the minds of the target audience regarding any brand. Celebrities
generate a higher level of attention because they have the power to grab the eyeballs of the customers and stand out from the clutter of other advertisements in a particular medium. A celebrity who is endorsing a product might be successful in creating an awareness of the brand but there are instances wherein the celebrity has been very powerful and has overshadowed the brand, and the target audience just remembers the celebrity but fails to recall the product category or the brand. Some celebrities who are very popular are roped in by several companies for several product categories thus resulting in overexposure of the celebrities leading to poor brand recall and confusion among the target audience. Celebrities also charge a very high contracting fee for endorsing brands. The ad legend and father of advertising David Ogilvy has explained; A celebrity testimonial always had a below-average ability to win over consumers who are of the belief that the celebrity is paid a huge sum of money for giving that testimonial.

1.1 Indian Innerwear Industry:
The innerwear category estimated at Rs 27,931 crore, accounts for 10% of the total apparel market and is expected to grow at a compounded annual growth rate of 10% over the next decade to Rs 74,258 crore. Experts feel innerwear is evolving from being functional to a segment with a fashion quotient. It's also shifting from a price-sensitive category to a brand-sensitive one.

1.2 Top Innerwear Brands Endorsed by Celebrities in the Indian Market
1.2.1 Amul Macho
J G Hosiery Private Limited is a Non-govt company, incorporated on 02 Apr 2001. Amul Macho is a brand owned by J G Hosiery. Over the years, the brand has always been a contemporary definition of machismo for Indian men. It has emerged as one of the leading innerwear brands in India. Bollywood actor Saif Ali Khan is endorsing the Amul Macho innerwear, currently.

1.2.2 Dixcy Scott
Dixcy was founded in 1982 by Shri Prem Prakash Sikka. Dixcy has evolved from an innerwear brand to a lifestyle brand over the last 32 years. It is being endorsed by Salman Khan and is one of the successful innerwear brands in India.

1.2.3 Dollar Bigboss
Shree Dindayal Gupta established the company Dollar in the year 1972. It became Dollar Industries Ltd in 2008. It started with the brand Dollar, and then Dollar club range of vest and briefs added mileage to the brand. Akshay Kumar is endorsing it.

1.2.4 Rupa
Rupa was established by Mr.P.R Agarwal. Rupa is the first company that introduced celebrities to endorse their product in India in the mid-1980s. They signed Bollywood stars such as Sanjay Dutt and Govinda to endorse their product. Presently they have a tie-up with Ranveer Singh for promoting their product.

1.2.5 Lux Cozi
It is a brand of men's underwear which is part of the Lux Industries Ltd. based in Kolkata. It was established in the year 1963. This brand is presently being endorsed by Varun Dhawan.

1.2.6 VIP Macroman
For more than 40 Years, VIP has been consistently delivering quality products that provide comfort to the consumers. VIP offers products to the consumers which are affordable by average Indian. Presently it's being endorsed by Hrithik Roshan.

Fig. 1.1 : Brands of Innerwear Endorsed by Celebrities in India
2. Literature Review

Celebrity endorsements are glamorous and effective but the selection of a celebrity depends on the cultural values that they display, as the cultural values or meanings are passed from the celebrity to the product first and then from the product to the consumer [2] [3]. Using a celebrity definitely enhances the chances that a brand is positively positioned in the minds of the customers, however the qualities or variables used to choose the celebrity who matches with the brand needs to be carefully researched [4][5]. Findings of several research studies on celebrity endorsements confirm the impact of celebrities on customer brand perception. These studies also emphasize the impact of the celebrity credibility on brand credibility and customer-based brand equity [6][7] [8].

Atkin and Block (1983) studied the effect of celebrity endorsements on liquor brands and found that while the younger consumers were influenced the most by the celebrities, for the older consumers the influence of celebrities was limited [9]. The image that a brand has is enhanced multifold when a strong or famous personality is used for endorsement.

Kahle and Homer (1985) studied how the physical attractiveness of a celebrity matters in a consumer's likability to use the product thereby influencing the purchase intention of the consumers [10].

Agrawal and Kamakura (1995) discussed how celebrity endorsement contract announcements are considered to be worth the advertising expenses as, on average, the stock prices of the shares were positively influenced by such announcements[11].

The cultural dimensions of every country also influence the way celebrity endorsements are perceived in different countries depending on the level of context and individualistic or collectivistic nature of the audience [12].

Carroll (2009) conceptualized that the fashion industry has been open to celebrity campaigns and moved away from traditional campaigns [13]. Celebrities are chosen to endorse brands as the target market finds it easier to believe celebrities than non-celebrities. There is some accountability when a celebrity endorses a brand than a non-celebrity[6]

When a company invites a celebrity to endorse a brand, it hopes the brand will benefit from customers' awareness of the celebrity, which could include perceptions of quality, educational value, or a certain image[14]. Studies have shown that celebrity endorsements used appropriately can serve a valuable role in developing brand equity and enhancing the brand's competitive position [15]. There is little research suggesting that it has a significant effect on brand loyalty.

Fig. 2.1 McCracken Meaning Transfer Model:

McCracken (1989) explains the effectiveness and importance of celebrity by assessing the meaning that consumers are linked with endorsers and gradually transfer to the brand. [2]. The author explains that it consists of 3 stages. First, the meaning associated with the famous person moves from the endorser to the product or brand. Thus meanings attributed to the celebrity become associated with the brand in the consumer's mind. Finally, in the consumption process, brand meaning is acquired by the customer. The third stage of the model shows the importance of the consumer's role in the process of endorsing brands with famous persons. The meaning transfer process is shown in fig.2.1

2.1 Research Objectives

1. To examine the impact of celebrity endorsement on the purchase intention of men's innerwear.
2. To analyze the overall customer perception of celebrities endorsing innerwear brands
3. To find out the target market that is influenced by
4. To know whether the brand itself plays an important role or celebrity has got any influence in the customer buying behavior of innerwear.

2.2 Research Questions
The scope of the study is to know about celebrity endorsement in India and its impact on customer's purchase intention and buying behavior with products like inner wears.

The study also intends to find out whether endorsement of innerwear brands by celebrities makes the individuals to buy innerwear brands or are there any other factors that impact the buying decision of the customers.

In this scope, the basic research questions of the study are given below:

RQ1: How do people perceive the innerwear brands endorsed by celebrities?
RQ2: Does the brand play an important role or celebrity has got any influence in the customer buying behavior of innerwear?

3. Methodology
This study intends to find out how consumers perceive the use of celebrities for endorsing innerwear brands. The study has used data from both primary and secondary sources.

3.1 Primary data: Conducted online surveys by sending mails to male respondents between the ages of 18 to 45. This age group is the primary market for innerwear in India.

3.2 Secondary data: Journals, reports, and research articles were referred for additional information on the innerwear brands.

Summarized data is obtained by tabulating the collected data. In this research, the data is collected through a questionnaire and was entered into SPSS software. This was further processed to obtain various outputs. The study used statistical methods of frequency tables, cross-tabulations, etc.

4. Results and Discussions
4.1 Data Interpretation:
4.1.1 To examine the impact of celebrity endorsement on buying behavior of men's innerwear.
The researchers attempted to know if there is an impact of celebrity endorsement on buying of innerwear. Respondents were asked if they buy innerwear brands based on their brand preference. The responses were recorded on a Likert scale (5) ranging from strongly agree, agree, neither agree or disagree, disagree, strongly disagree. Frequency distribution was used to analyze the results.

In the analysis, 67.78% of respondents agree that they purchased based on their brand preference, and 16% of respondents disagree with this, and 15.5% of respondents were neutral. The results indicate that the impact of celebrity endorsement on buying of innerwear is minimal, as most of them go on purchasing based on their brand preference.

4.1.2 To analyse the customer perception of celebrities endorsing innerwear brands.
To know the opinion of customers regarding celebrities’ endorsing the product such as innerwear the respondents were asked if they had an attractiveness effect towards innerwear if a celebrity would endorse a brand. Frequency distribution indicates that 53.33% of respondents disagree that they are attracted to a celebrity endorsement. The inference of this study is that celebrity endorsement does not influence the customers buying of inner wears.

4.1.3 To find out the target market that is influenced by celebrity endorsement.
To find the target market that is most influenced by celebrity endorsement, cross-tabulation was done taking age group and celebrities as two components. Interestingly, it was found out that the age group between 19-25 is positively influenced by celebrity endorsement.

4.1.4 To know whether the brand itself plays an important role or celebrity has got any influence in the customer buying behavior of innerwear.
The item used to measure this objective was "I had purchased innerwear brands when they have been endorsed by my favorite celebrities". 54.44% of respondents disagree that they purchase the inner wears when it is being endorsed by their favorite celebrity. 13.33% of respondents agree to that statement and
32.22% of respondents are neutral as they neither agree nor disagree. The inference is that buying behavior displayed by consumers is different from the brands that have created an impact on the consumers due to celebrity endorsement. The purchases are based on their brand preference, quality, and style. Celebrities may have an impact on the purchase of textile brands because there comes a matter of pride, trust in celebrities that plays a major role but in case of innerwear, consumer buying behavior was influenced by their innate comfort and attributes that they want in the product.

4.2 Other Findings:

4.2.1 Channel or Mode of Buying Innerwear - Multiple brand outlets, departmental stores, hypermarket, brands own showroom and online retailers.

It was found out that consumers prefer to purchase innerwear in multiple brand outlets. 41.11% have opted for it and then followed by Brand's own showroom that is 25.55% and then is followed by departmental stores, hypermarkets and lastly Online retailers.

4.2.2 Source of Awareness

The respondents were asked to choose the top three sources of awareness. TV commercials, Social media marketing, Print media ( magazines and newspapers) Internet marketing Hoarding/ banners, Event sponsorship by brands

It was found that the source of awareness for target respondents is TV commercials, Social media marketing and Print media (magazines and newspapers).

4.2.3 Role of the brand name while buying innerwear

Respondents were asked if the brand name matters while the purchase of men's innerwear and 58.88% of respondents agree that brand name plays a major role in the purchase of men's innerwear 22.22% of people disagree to this 18.88% of people neither agree nor disagree.

4.2.4 The three most important factors considered while purchasing innerwear

The respondents were asked the three most important factors considered while the purchase of innerwear and from the analysis it was found that they prefer quality, comfort and brand name.

4.2.5 Attitudes and perceptions about the use of celebrities in ads

In order to measure the level of agreement with all these statements, a one-to-five point scale which ranged between "strongly disagree" and "strongly agree" was used.

In this section, the means and standard deviations of the eight statements reveal attitudes towards the use of celebrities for endorsing innerwear brands.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertisements impact my purchase of innerwear brands</td>
<td>3.01</td>
<td>1.22</td>
</tr>
<tr>
<td>I am attracted to celebrities endorsing innerwear brands</td>
<td>2.33</td>
<td>1.167</td>
</tr>
<tr>
<td>I purchase innerwear based on my brand preference</td>
<td>3.70</td>
<td>1.19</td>
</tr>
<tr>
<td>Price is not a concern when I purchase a brand of inner wear that is endorsed by my favorite Bollywood heroes</td>
<td>2.93</td>
<td>1.09</td>
</tr>
<tr>
<td>Brand name plays a main role in the purchase of innerwear</td>
<td>3.45</td>
<td>1.21</td>
</tr>
<tr>
<td>I have purchased innerwear brands when they have been endorsed by my favorite Bollywood heroes</td>
<td>2.41</td>
<td>1.01</td>
</tr>
<tr>
<td>I watch TV commercials of innerwear brands to watch my favorite Bollywood heroes</td>
<td>2.31</td>
<td>1.11</td>
</tr>
<tr>
<td>Celebrities have an impact on the sale of innerwear brands</td>
<td>2.77</td>
<td>1.21</td>
</tr>
</tbody>
</table>

Source: Field Survey

The arithmetic means of the statements vary between 2.31 and 3.70. The first statement "Advertisements impact my purchase of innerwear brands," has an average of 3.01 arithmetic mean and 1.22 standard deviation. Therefore, this may mean that when people see advertisements, it leads viewers to direct their attention to those ads and may have an impact on their purchase. The statements "I purchase innerwear based on my brand preference" and "Brand name plays a main role in the purchase of innerwear" with a mean of 3.70, 3.45 and a standard deviation of 1.19 and 1.25
respectively mean that consumers final purchases are based on their brand preference and the brand name of the product. The more famous or luxurious a brand is perceived, the consumer would want to use the brand.

The consumers are not affected by celebrities endorsing a brand, they will also not pay a premium for celebrities endorsing a brand. While consumers have their favorite celebrities, this does not assure that they would buy a product they see their favorite celebrity endorsing.

With a mean of 2.31 and a standard deviation of 1.11, consumers would not continue watching an advertisement of innerwear brands just because their favorite celebrity is endorsing the brand.

It is also clear that the impact of celebrities on the sale of innerwear brands is not very significant.

5. Conclusion
The study tells us about the impact of celebrity endorsers over the consumers on buying men's innerwear and the study concludes that customers buy based on their brand preference, quality, comfort and also price. Celebrities are paid a huge fee for brand endorsement as the competition is fierce in the market for the products that are not premium in nature. Premium brands do not need any celebrity to endorse as they have built their image and reputation in the market. To sustain in the market a brand has to be superior than other which a celebrity’s image can bring into the product and make it superior and also bifurcate the brand celebrity endorsement are undertaken because sometimes all factors are same in the vest and brand name is different and if the brand tag is removed from the vest there will be no difference in vest all might look same. Thus celebrities are useful in this case. As per the findings from the study, celebrities may be useful for the identification of brand but it doesn’t have any impact on the buying pattern of men’s innerwear.

References:
Thermal and Flame Retardant Properties of FR Viscose Fibre and its Blends

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Abstract

Inherent flame retardant fibres such as Aramids, FR-viscose, Modacrylic etc are widely used for making durable flame retardant clothing for the workers working in petrochemical, foundries, aerospace, fire-fighting, defense etc. Although the clothing made out of these fibres are well known for protection against fire hazards, however sometimes these clothing are also required to have additional comfort properties. In this study, to achieve additional comfort properties, FR-Viscose fibre is blended with Nylon 6 6, Modacrylic, Thermo-cool and Meta-aramid fibres to develop binary blended yarns on ring spinning system. These yarns are converted into 17 woven fabrics having same constructional parameters. These fabric samples are evaluated for durability, safety (heat & flame) and comfort properties. It is observed that with the addition of FR-Viscose fibre in the various blends, comfort properties are improved with decrease in durability (tensile, tear and abrasion strength). Multivariate analysis of variance (MANOVA) has been applied to find out the effect of presence of FR-Viscose in binary blends on various heat & flame properties. It is observed that there is relationship between FR-Viscose fibre contents in the blend and heat & flame resistant properties.

Keywords

Aramid fibres, Convective heat, FR viscose, LOI, Radiant heat

1. Introduction

In order to provide protection from various occupational hazards like chemical, biological, nuclear, bullet, knives, flame, radiant heat, hot liquid, steam etc, varieties of specialized protective clothing have been developed, and are widely used by workers in the industrial and government sectors. These specialized protective clothing can be categorized as chemical protective clothing, biological (microbial) protective clothing, nuclear protective clothing, puncture- or cut-resistant (bullet-/knife-proof) protective clothing, and thermal (flame and heat) protective clothing [1]. Among these types of specialized protective clothing, thermal protective clothing has a particular significance.

It is well known fact that the conventional clothing fabrics made from natural fibers, polyester fibers and nylon fibers can ignite and continue to burn. In addition to this, fabric made out of thermoplastic fibers like polyester and nylon are having melting and dripping properties which can lead to more severe burn injuries to the wearers [2]. To protect the wearers from such fire hazards there is a need of fire-retardant clothing. This can significantly reduce the extent and severity of burn injuries. Beside this, it provides time to the wearer to get away from burning environment. Therefore, fire-retardant clothing should protect wearer from fire and heat by providing insulation as well as high dimensional stability of the fabrics, so that, upon exposure to the high heat fluxes that are expected during the course of the wearer’s work, they will neither shrink nor melt [3].

Inherent flame retardant fibres such as Aramids, FR-viscose, Modacrylic etc are widely used for making durable flame retardant clothing. These fibers come in the category of heat-resistant and strong synthetic fibers and can be used for making various protective gears [3] in petrochemical, foundries, aerospace, fire-fighting, military applications etc. Although these fibres provide good protection against flame and heat, sometimes the clothing made out of these do not fulfill the requirements of the user in terms of comfort (except FR-Viscose) and high abrasion resistance. To fulfill

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E-M ail: drmsparmar@nitratextile.org
These fibres are blended with each other or with other fibres keeping in mind the end use application. For example, Nylon 6, 6 is found to be having excellent abrasion resistance property. The melting point of this polymer is 268°C, which is high for synthetic fibers[4]. This property makes it heat and friction resistance and also exhibits high abrasion resistance and self-lubricating properties. It has high thermal stability, fire resistance, draw ability, good appearance and good process ability. The comfort properties of any synthetic fibre made clothing can be improved upon by adding cellulose based fibres or some engineered synthetic fibre in the blend. Blending Metaaramid or Modacrylic fibres with FR-viscose fibres may be one of the option for improving comfort property of resultant fabric[5]. Thermo-Cool is another option which may be explored for such cases. Thermo-Cool fibre is a multi-functional and ecological evolutionary technology designed to optimize the body's natural thermoregulation capabilities through smart fiber cross-sections.

In this study, rip stop woven fabric samples of FR-Viscose with Nylon 6 6, Modacrylic, Thermo-cool, and Meta-aramid in binary blends were developed. The effect of FR-Viscose fibre in the binary blends on durability, safety (heat & flame) and comfort properties was evaluated.

2.0 Materials and Methods
All the fibres (Nylon 6, 6, Modacrylic, Thermo-cool, FR Viscose and m-Aramid) used in the study were procured from M/s Invista Industry Pvt. Ltd., M/s Jayshree Industry Ltd., M/s Advansa Marketing GmbH, Germany, M/s Lenzing India Pvt. Ltd. and M/s Teijin Industry Pvt. Ltd. These fibres were spun individually and also blended with other fibres to enhance the characteristics such as durability, safety (heat & flame) and comfort properties. Fibre properties such as fibre length, denier, tenacity & elongation and moisture regain of all the fibres were tested using IS 10014 Part-1, ASTM D 1577, ASTM D 3822 and IS 199 standard test methods respectively. The test results of fibre properties are given in Table-1.

These fibres (individually and binary blends) were converted into 20s count yarn using ring spinning system. The various physical properties such as tenacity along with elongation and CSP of these yarn were tested as per test methods IS 1670 and IS 1671 respectively. The test results are given in Table-2. The coding of yarns is also given in the Table-2. Same coding was used for fabric samples also.

The manufactured yarns (same yarn in warp and weft) were converted into plain rip stop woven fabrics (Ends/inch: 80 and Picks/inch: 60) on CCT’s automated sampling rapier loom. These fabric samples were washed in hot water for the duration of 30 minutes to remove sizing lubricants followed by heat setting (depending upon the fibre type except FR viscose) in the laboratory curing chamber. Finally, the fabrics were evaluated using standard test methods for various mechanical, heat & flame retardant and comfort properties after giving 5 washes as per ISO 6330-2A test procedure. Fabric mass in g/m2, tensile strength, tear strength, thickness and taber abrasion were evaluated using IS: 1964, ISO 13934-1, ISO 13957-2, IS 7702 and ASTM D 3884 test methods respectively. In the taber abrasion method, numbers of cycles required to break two threads (hole formation) of the fabric, is determined by using CS-10 abrasive wheels and 500 g load onto the specimen surface.

Air permeability of textiles indicates their breathability. The air permeability of fabrics was determined using WIRA Air Permeability Tester following IS: 11056 test method which indicates the amount of air passing through test specimen on the scale reading, in terms of cc/cm²/sec. ASTM E96 / E96M test method was followed to test water vapour permeability. The measurements determine how many grams of moisture (water vapour) passes through a square meter of fabric in 24 hours. If a fabric represents low vapour permeability it would be unable to pass sufficient perspiration and this could lead to sweat accumulation in the clothing and hence discomfort. However in this study mg/cm²/sec unit is used for water vapour permeability.

Limiting Oxygen Index, Contact heat transmission, Radiant heat transfer index, convective heat transfer index and limited flame spread tests were performed on all the fabric after 5 washes. Various tests were carried out to determine the thermal and FR properties of the fabrics. Limiting Oxygen Index of fabrics was tested following IS: 13501 test method after conditioning in a standard atmosphere of 65±2 % relative humidity and 27±2 degree Celsius temperature. The burning behaviour of textile materials was reviewed in terms of their ability to generate flammable volatile liquids and gases under the action of heat and their subsequent ignition [6, 7]. The oxygen index was calculated...
Limited Oxygen Index (LOI) % = \frac{[O_2] \times 100}{[O_2] + [N_2]}

where [O_2] is the volumetric flow of oxygen in cm³/s; and [N_2], the corresponding volumetric flow rate of nitrogen in cm³/s.

ISO 12127-1 test method was followed for determination of contact heat transmission on contact heat tester. A heating cylinder was heated to 500°C and maintained at the contact temperature and a test specimen was placed on the calorimeter. The heating cylinder was lowered onto the test specimen supported by the calorimeter or, alternatively, the calorimeter with the specimen was lifted up to the heating cylinder. In either case, the operation was carried out at a constant speed. The threshold time was measured by monitoring the temperature of the calorimeter and registered to an accuracy of ± 0.1°C.

Radiant heat transfer index of all fabrics were determined as per ISO 6942 method B test method. According to ISO 6942 test method, fabrics were exposed to radiant heated source emitting 40 kW/m² heat fluxes. The time, in seconds, for the temperature in the calorimeter to rise (24 ± 0.2)°C is recorded. The heat flux density, Q, in kW/m², is determined from the following equation:

\[ Q = \frac{M \cdot C_p \cdot R}{A \cdot \alpha} \]

where M is the mass of the copper disc in kilograms; C_p is the specific heat capacity of the copper \([= 0.385 \text{ kJ/ (kg.°C)}]\); R is the rate of rise in disc temperature in the linear region in degrees Celsius per second; A is the disc area in square meters.

The Limited flame spread test was carried out as per ISO 15025. There are two procedures: Procedure A- Surface ignition and Procedure B- Edge ignition under this test. Both procedures were carried out on the fabric samples. The test was performed in an atmosphere having a temperature between 10°C to 30°C, and relative humidity between 15% and 80%.

The experimental data obtained from various studies was analyzed using SPSS (Version 20). Multivariate analysis of variance (MANOVA) was applied to compare means. If there is no relationship between varying FR-Viscose fibre ratio in the blend with LOI, Contact heat, Radiant heat, convective heat, and limited flame spread, then it is considered as null hypothesis (Ho). Null hypothesis will be rejected when the p-value turns out to be lower than a predetermined significance level of 0.05.

3. Results and Discussion:

3.1 Mechanical and comfort properties:

From the Table 3 it is clear that the mass of the fabric varies from 174 to 194 g/m². The variation in mass is found not much as the yarn count and fabric construction was not altered.

Abrasion of the fabric can lead to a reduction in weight, thickness, and eventually the failure of the fabric, with a hole forming, which exposes the wearer directly to electric arc or fire threat. Having fabrics made of improved abrasion resistance yarns can result in longer lasting protective garments. It is clear from Table 3 that N fabric did not show hole formation even after 1000 taber abrasion cycles, while T, M, V and mA fabric samples got abraded as two treads are broken in 800, 157, 58 and 569 cycles respectively. The results show expected trends as N1 (made out of 100% Nylon 66) is having high abrasion resistance characteristics.[8]. It is clear from the Table 3 the presence of FR Viscose in the blend with other fibres affect the abrasion resistance property adversely because 100% FR viscose fabric (V) is having very poor abrasion.
resistance.
The tensile and tear strength of all the fabric samples was tested after five washes. The results are given in the Table 3. It shows that N (Nylon 66), T(Thermo-cool) and mA (m-Aramid) samples are having higher tensile strength (Warp wise 1054 to 1059 N and weft wise 928 to 989 N) than other fabrics. The tensile strength of V(FR- Viscose: warp wise 485 N and weft wise 480 N) was found to be lowest. The tensile strength of M (Modacrylic) was found to be 645 N in warp wise and 620 N in weft wise. As all the construction parameters of fabric samples were similar, the change in tensile strength was due to the difference in the tenacity of the fibres as well as yarn. Nylon 66 (N) is having higher fibre and yarn tenacity (Table 1 and Table 2) than other.

### Table 1: Physical properties of Fibers

<table>
<thead>
<tr>
<th>Fiber Properties</th>
<th>Fibres</th>
<th>Length (mm)</th>
<th>Denier</th>
<th>Tenacity (g/tex)</th>
<th>Elongation (%)</th>
<th>Moisture Regain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nylon</td>
<td>38</td>
<td>1.60</td>
<td>48.51</td>
<td>27.46</td>
<td>3.49</td>
</tr>
<tr>
<td></td>
<td>Thermo-66</td>
<td>38</td>
<td>1.49</td>
<td>34.38</td>
<td>27.45</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Meta-aramid</td>
<td>51</td>
<td>2.39</td>
<td>28.26</td>
<td>36.25</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>FR Viscose</td>
<td>40</td>
<td>2.06</td>
<td>25.83</td>
<td>25.29</td>
<td>7.11</td>
</tr>
<tr>
<td></td>
<td>FR Viscose</td>
<td>51</td>
<td>1.98</td>
<td>24.21</td>
<td>13.78</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Physical properties of yarn with code

<table>
<thead>
<tr>
<th>Yarn composition</th>
<th>Code (g/tex)</th>
<th>Tenacity (%)</th>
<th>Elongation (%)</th>
<th>Count Strength Product (CSP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nylon 6,6</td>
<td>N</td>
<td>26.1</td>
<td>21.0</td>
<td>3843</td>
</tr>
<tr>
<td>Thermo-cool</td>
<td>T</td>
<td>23.0</td>
<td>18.2</td>
<td>2808</td>
</tr>
<tr>
<td>Modacrylic</td>
<td>M</td>
<td>13.0</td>
<td>18.0</td>
<td>2024</td>
</tr>
<tr>
<td>FR Viscose</td>
<td>V</td>
<td>12.8</td>
<td>7.8</td>
<td>2121</td>
</tr>
<tr>
<td>Meta- Aramid</td>
<td>mA</td>
<td>23.5</td>
<td>14.8</td>
<td>3843</td>
</tr>
<tr>
<td>FR viscose: Thermo-cool</td>
<td>VT37</td>
<td>19.1</td>
<td>17.8</td>
<td>2636</td>
</tr>
<tr>
<td>FR viscose: Thermo-cool</td>
<td>VT55</td>
<td>17.3</td>
<td>16.2</td>
<td>2516</td>
</tr>
<tr>
<td>FR viscose: Thermo-cool</td>
<td>VT73</td>
<td>15.5</td>
<td>9.3</td>
<td>2310</td>
</tr>
<tr>
<td>FR Viscose: M-Aramid</td>
<td>VmA37</td>
<td>19.2</td>
<td>8.7</td>
<td>2914</td>
</tr>
<tr>
<td>FR Viscose: M-Aramid</td>
<td>VmA55</td>
<td>16.4</td>
<td>8.2</td>
<td>2780</td>
</tr>
<tr>
<td>FR Viscose: M-Aramid</td>
<td>VmA73</td>
<td>14.0</td>
<td>8.8</td>
<td>2507</td>
</tr>
<tr>
<td>FR Viscose: Modacrylic</td>
<td>VM37</td>
<td>14.2</td>
<td>12.0</td>
<td>2234</td>
</tr>
<tr>
<td>FR Viscose: Modacrylic</td>
<td>VM55</td>
<td>15.1</td>
<td>13.1</td>
<td>2485</td>
</tr>
<tr>
<td>FR Viscose: Modacrylic</td>
<td>VM73</td>
<td>14.5</td>
<td>11.9</td>
<td>2413</td>
</tr>
<tr>
<td>FR Viscose: Nylon 6,6</td>
<td>VN37</td>
<td>22.29</td>
<td>21.43</td>
<td>3024</td>
</tr>
<tr>
<td>FR Viscose: Nylon 6,6</td>
<td>VN55</td>
<td>19.15</td>
<td>11.65</td>
<td>2905</td>
</tr>
<tr>
<td>FR Viscose: Nylon 6,6</td>
<td>VN73</td>
<td>16.95</td>
<td>8.40</td>
<td>2489</td>
</tr>
</tbody>
</table>
Due to this it tensile strength is higher than other fabrics. On the other hand as per Table 1 and Table 2 fibre and yarn tenacity of FR viscose (fibre tenacity: 24.21 g/tex, yarn tenacity: 12.8 g/tex) is lower than other fibres.

This may be the reason of lowest tensile strength of the fabric made out of this fibre.

Tensile strength results of blended fabrics VT37, VT55 and VT73 are given in Table-3. It is clear from the table that with the increase of FR-Viscose percentage from 30% to 70%, tensile strength of the fabric samples is decreases in both the directions. The reason of such decrease is due to the fact that as the FR-Viscose is having low tenacity, increase in percentage of this fibre in the blend, decrease overall tensile strength. Similar trends can be seen in other blends (VM-A37, VM-A55, VM-A73, VM37, VM55, VM73, VN37, VN55 ad VN73).

Like tensile strength, tear strength of N, T and mA fabric samples are found to be higher than other fabric samples as mentioned in Table-3. The tear strength is directly proportional to yarn strength. Higher the yarn strength, higher will be the tear strength.[9]. From the Table 2, it is clear that Nylon 66 (N) yarn is having higher tensile strength than others. Due to this reason, the fabric made out of this yarn is having higher tear strength than other fabrics. On the other hand FR-Viscose yarn is having lowest tensile strength, due to this fabric made out of this is having lowest tear strength. Similar inference can be drawn from the various blends of all the fibres.

The air permeability of a fabric is affected by many factors, such as fibre fineness, structural properties (shape and value of pores of the fabric), and the yarn and fabric thickness[10,11]. As per the results given in Table 3, fabric coded as V shows highest air permeability (28.1 ccs/cm²), while N shows lowest (10 ccs/cm²) air permeability. Lower thickness of 100% FR viscose fabric could be the reason for higher air permeability and higher thickness with higher mass could be the reason of low air permeability of fabric coded as N (Nylon 66). Similar conclusion may be drawn on the other fabrics results mentioned in the Table 3. Generally, it was seen that air permeability decreases

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sample code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass, (g/m²)</td>
<td></td>
</tr>
<tr>
<td>Abrasion resistance (No. of cycles for hole formation)</td>
<td>VT37 VT55 VT73 mA37 mA55 mA73 VM37 VM55 VM73 VN37 VN55 VN73</td>
</tr>
<tr>
<td>Tensile strength (N)</td>
<td>VT37 VT55 VT73 mA37 mA55 mA73 VM37 VM55 VM73 VN37 VN55 VN73</td>
</tr>
<tr>
<td>Tear strength (N)</td>
<td>VT37 VT55 VT73 mA37 mA55 mA73 VM37 VM55 VM73 VN37 VN55 VN73</td>
</tr>
<tr>
<td>Air permeability (cc/s/cm²)</td>
<td>VT37 VT55 VT73 mA37 mA55 mA73 VM37 VM55 VM73 VN37 VN55 VN73</td>
</tr>
<tr>
<td>Water vapour permeability (mg/cm²/sec)</td>
<td>VT37 VT55 VT73 mA37 mA55 mA73 VM37 VM55 VM73 VN37 VN55 VN73</td>
</tr>
<tr>
<td>Thickness, mm</td>
<td>VT37 VT55 VT73 mA37 mA55 mA73 VM37 VM55 VM73 VN37 VN55 VN73</td>
</tr>
</tbody>
</table>
as mass per unit area, thickness, and density of fabric, increase and diameter of fiber constituting the fabric decreases [12].

Water vapour permeability determines breathability of the clothing material. The mechanism involved in water vapour transmission through fabric from the skin to the outer surface by diffusion and absorption - desorption method[13]. Water vapour permeability of T fabric (Fabric made of thermo Cool fibre) is found high (15.1 mg/cm²/s) as compared to other fabrics (Table 3). It is claimed that Therm-cool fibre ensures quick moisture transfer due to its multi-channeled structure [14]. On the contrary, amongst blended fabrics, FR-viscose/Thermocool (30:70) blends (coded as VT37) in Table 3 show higher water vapour permeability (13.1 mg/cm²/s). The reason may be due to present of higher percentage (70%) of thermocool fibre. Nylon 66 (coded as N) and modacrylic (coded as M) made fabric have shown lowest water vapour permeability. Their blends also have shown similar trends. The earlier study [13] also indicated that the fabric made out of these fibres have low water vapour permeability.

3.2 Flame-retardant properties

Fabric flammability is an important issue, especially for uniform worn during working in industries like foundries, Oil and Gas industries, fire fighting etc. Flame-retardant clothing neither ignites nor continues to burn when it comes in contact with the flame. It not only reduces burn injury, but also provides escape time and

### Table 4 : FR Properties of developed fabrics (After 5 washes)

<table>
<thead>
<tr>
<th>Parameter (surface &amp; Edge ignition)</th>
<th>N</th>
<th>T</th>
<th>M</th>
<th>V</th>
<th>mA</th>
<th>VT37</th>
<th>VT55</th>
<th>VT73</th>
<th>Vm37</th>
<th>Vm55</th>
<th>Vm73</th>
<th>VN37</th>
<th>VN55</th>
<th>VN73</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOI, %</td>
<td>21</td>
<td>18</td>
<td>31.5</td>
<td>27</td>
<td>27.5</td>
<td>21</td>
<td>22.5</td>
<td>23</td>
<td>28</td>
<td>30</td>
<td>29.5</td>
<td>36</td>
<td>29.5</td>
<td>27</td>
</tr>
<tr>
<td>Contact heat index, sec.</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Radiant Heat Transfer Index (RHTI30), sec.</td>
<td>10.0</td>
<td>13.4</td>
<td>12.3</td>
<td>11.0</td>
<td>12.6</td>
<td>13.0</td>
<td>12.5</td>
<td>12.3</td>
<td>11.9</td>
<td>11.4</td>
<td>11.0</td>
<td>12.4</td>
<td>12.1</td>
<td>11.8</td>
</tr>
<tr>
<td>Convection heat transmission (HTI30), sec.</td>
<td>3.5</td>
<td>2.9</td>
<td>5.0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
<td>0.9</td>
<td>5.2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.9</td>
<td>3.2</td>
<td>5.8</td>
<td>5.3</td>
</tr>
<tr>
<td>Limited Flame Spread of developed fabrics</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>i) Whether any flaming reaches the top edge or either side edge</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>ii) Whether a hole develops (only for surface ignition)</td>
<td>25</td>
<td>32.8</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>50.2</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>81.8</td>
<td>Nil</td>
</tr>
<tr>
<td>iii) Occurrence of flaming melting debris</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>iv) After flame time (sec.)</td>
<td>v) After glow time (sec.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
increases chances of survival. This could mean a difference between life and death for valuable human lives. Hence, it is important to test the fabrics to evaluate their heat and flame properties like limiting oxygen index, contact heat index, radiation heat transfer index, convective heat index and limited flame spread.

3.2.1 Limiting oxygen index

Limited oxygen Index of Inherent flame retardant fibres such as FR-Viscose (27%), Modacrylic (31.5%) and Meta-aramid (27.5%) are found to be higher compared to Nylon 66 (21%) and Thermo-cool (18%) fibres as shown in the Table 4. It is clear from the Table 4 that the individual blends of FR-Viscose with Meta-aramid and Modacrylic are showing LOI from 27 to 30%. The results are on expected line as all of these blends are made out of inherent FR fibres (FR-Viscose, Meta-aramid and Modacrylic) having LOI values ranging from 27 to 31.5%. It is also explicit that with the inclusion of non FR fibres such as Nylon 66 and Thermo-cool, the LOI value start decreasing depending upon the percentage of such fibres. Higher the percentage of such fibres in the blend, lower is the value of LOI. As shown in the table VT37 (30% FR-Viscose and 70% Thermo-cool) is having 21% LOI while VT73 (70% FR-Viscose and 30% Thermo-cool) having 23% LOI. Similarly VN37 (30% FR-Viscose and 70% Nylon 66) is having 23% LOI and VN73 (70% FR-Viscose and 30% Nylon 66) is having 26% LOI. It is well known fact that fibres having LOI values of 21% or below ignited easily and burn rapidly in air (around 21% Oxygen). On the other hand fibres with LOI values above 21% ignite and burn slowly. Generally fibres having LOI values above 26%, may be considered as flame retardant [15].From the Table 4, on the basis of LOI results, fabrics coded as M (31.5%), V (27%), mA (27.5%), VmA37 (28%), VmA55 (30%), VmA73 (29.5%), VM37 (30%), VM55 (29.5), VM55 (27%), VN55 (25.5%) and VN73 (26%) may be considered as flame retardant.

3.2.2 Contact heat transmission

Contact heat transmission test method is applicable to protective clothing (including hand protectors like gloves) and its constituent materials intended to protect against high contact temperatures. It is clear from the Table 4 that VmA37 (FR Viscose: Meta Aramid:: 30% : 70%) had the highest threshold time (8 seconds) for contact heat index. The reason of higher heat contact transmission of this m-aramid blended fabric is due to highly oriented rigid molecular structure of aramid, which make it high heat resistance. Even 100% M-Aramid fabric (mA) is having higher threshold time after VmA37 as compared to other fabrics.

3.2.3 Radiation heat transfer index (RHTI)

It is a number, to one decimal place calculated from the mean time (measured in seconds, to one decimal place) to achieve a temperature rise of (24±0.2)°C in the calorimeter when testing by this method with a specified incident heat flux density. Higher is the time taken to raise temperature of the calorimeter to (24±0.2)°C, better will be the fabric in radiant heat resistance point of view. From the Table 4, it is clear that radiant heat transfer index (RHTI24) of the fabric coded as T (100% Thermocool fabric) is higher (13.4 seconds) than others. Fabric coded as N (Nylon 66) is having lowest RHTI24 (10.0 seconds) compare to other. The melting point (Tm) of thermoplastic polymers like Nylon 66 is around 265°C. The Tm value of this polymers is much lower than the temperature of pyrolysis or decomposition temperature (Tp) value (403°C), and thus tends to become fluids before they start to decompose. This physical property of the polymer greatly influences its fire performance. Glass transition temperature (Tg) of Nylon 66 is around 50°C. Due to low glass transition temperature these fibre cannot provide protection against radiant heat[16]. It is also clear from the table-4 that blends of Nylon 66 with FR viscose (VN37, VN55 and VN73) does not improve radiant heat transfer index.

Amongst the all fabrics, fabric coded as T (Thermocool) is showing highest RHTI24 (13.4). As per the manufacturer, THERMOCOOL fiber combines multi-channel and hollow fibers: during physical activity or in case of high temperature multi-channel fibers allow maximum breathability, while the innermost fibers allow better air circulation, ensuring optimum process thermoregulation. That may be the reason that during exposure to radiant heat, it regulate radiant heat and thus give higher heat transfer index. The blends of thermocool with FR Viscose (VT37, VT55 and VT73) also show better RHTI24 (12.3 to 13 seconds) compare to other blends.

Modacrylic fabric (coded as M) and Meta-aramid fabric (Coded as mA) are having almost same RHTI24 i.e. 12.3 seconds and 12.6 seconds respectively. Their individual blends (VmA37, VmA55, VmA73, VM37, VM55 and VM73) with FR viscose are also showing similar trends as given in the Table-4.

3.2.4 Convective heat transmission index (HTI)
The HTI24 values of FR viscose (V) and Mata aramid (M-A) fabrics are 6.1 seconds and 6.2 seconds respectively as shown in the Table 4. The fabric coded as T (Thermo-Cool) is showing lowest HTI24 values (2.9). The second lowest HTI24 value is of fabric coded as N (Nylon 66). The HTI24 value of modacrylic fabric (M) is 5.0 seconds. These results indicated that at around 80kw/m2 of heat flux, FR Viscose and Meta-Aramid fabric samples are giving more resistance to convective heat compare to other fabrics. Similar trends are seen in their blends (VmA37, VmA55 and VmA73).

Here also HTI24 values varied from 6.3 to 6.9 seconds. It is also evident from the table that the presence of FR -Viscose fibre in the individual blends of Nylon 66 and Thermo-Cool fibre improves the HTI24 value (VT37, VT55, VT73, VN37, VN55 and VN73). Higher the content of FR- Viscose fibre in the blends, higher is the HTI24 value. It was also seen from the table that there is with the increase of FR viscose contents in the FR Viscose and Modacrylic blends (VM37, VM55 and VM73), HTI24 value also increase from 5.2 seconds to 6.3 seconds. The reason of this increase may be due to the higher HTI24 value of 100% Viscose fabric (V) than 100% Modacrylic fabric (M) as shown in the Table-4.

3.2.5 Limited flame spread
In this study, a defined flame from a burner, as mentioned in the test method, is applied for 10 seconds to the surface or the bottom edge of vertically oriented fabric specimens. Fabric is analyzed for melting, spread of flame, afterglow time, after flame time, formation of debris, formation of hole etc. All the results of fabric samples are given in Table-4. From the Table 4 it is clear that except fabrics coded as N (Nylon 66), T (Thermo-Cool), VT37 (FR viscose and Thermo-Cool blend) and VN37 (FR viscose and Nylon 66 blend) all the samples are passing the passing the criteria of ISO 11612 standard for protective clothing against heat and flame. The results are on expected line. Nylon 66 and Thermo-Cool (based on polyester) are not flame retardant fibres as indicated their low LOI values in Table-4. Due to this reason these are failing in spread of flame top edge or either side, hole formation, occurrence of flaming melting debris and after flame time tests.

Flammability of fibres can also be determined by analyzing heat release rates. Higher the heat release rate, higher will be the flammability. In one of the study, it was found that cotton, rayon, silk, acetate, polypropylene, nylon and polyester have relatively high peak heat release rate (>200 W/g) whereas m-aramid was having very low relatively high peak heat release rate (780 W/g) when analysed by micro-scale combustion calorimetry [17]. Fabrics coded as VT 37 and VN 37 are having high content of flammable fibres (Thermo-Cool and Nylon 66 both having 70% content in blends), that may be the reason they are also failing in spread of flame top edge or either side, hole formation and after flame time tests.

4. Statistical analyses
Table 5 shows the result of Multivariate analysis of variance (MANOVA) which was applied to find out the effect of FR-Viscose fiber ratio in different blends on Limiting Oxygen Index, Radiation heat transfer index (RHTI24) and Convective heat transmission index (HTI24). The effect of fiber ratio in blend on LOI, contact heat index, radiation heat transfer index and convective heat index of fabric was found significant at 5 % level. The p value was found to be lower than 0.05. The result indicates that there is a relationship between FR-Viscose fiber content in the blends (VT37, VT55, VT73, VMa37, VMa55, VMa73, VM37, VM55, VM73, VN37, VN55 and VN73) and LOI, RHTI24 & HTI24 properties. }
5. Conclusions:

- Fabric coded as N (Nylon 66), T (Thermo-cool), M (Modacrylic) and mA (m-Aramid) samples are having higher tensile strength than other fabrics of same constructional parameters. The tensile strength of fabric coded as V (FR-Viscose) was found to be lowest. Increase in FR-Viscose percentage from 30% to 70% in the blends, decrease in tensile strength in both the directions were observed. The reason of such decrease is due to the fact that as the FR-Viscose is having low tenacity, increase in percentage of this fibre in the blend, decrease overall tensile strength. FR-Viscose yarn is having lowest tenacity, due to this fabric made out of this is having lowest tear strength.

- Fabric coded as V shows highest air permeability, may be due to lowest thickness.

- Water vapour permeability of fabric T fabric (Fabric made of Thermo-cool fibre) is found high as compared to other fabrics. Amongst blended fabrics, FR-Viscose/Thermocool blends (coded as VT37) showed higher water vapour permeability. The reason may be due to present of higher percentage (70%) of Thermocool fibre.

- It is also explicit that with the inclusion of non FR fibres such as Nylon 66 and Thermo-cool, the LOI value start decreasing depending upon the percentage of such fibres. Higher the percentage of such fibres in the blend, lower is the value of LOI.

- The RHTI24 of the fabric coded as T (100% Thermocool fabric) is higher than others. Fabric coded as N (Nylon 66) is having lowest RHTI24 compared to other. The blends of thermocool with FR Viscose (VT37, VT55 and VT73) also show better RHTI24 compared to other blends.

- The HTI24 values of FR viscose (V) and Mata aramid (M-A) fabrics are 6.1 seconds and 6.2 seconds respectively. The fabric coded as T (Thermo-Cool) is showing lowest HTI24 values. The second lowest HTI24 value is of fabric coded as N (Nylon 66). It is also evident from the study that the presence of FR-Viscose fibre in the individual blends of Nylon 66 and Thermo-Cool

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<th>F</th>
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fibre improves the HTI24 value (VT37, VT55, VT73, VN37, VN55 and VN73). Higher the content of FR-Viscose fibre in the blends, higher is the HTI24 value. The increase of FR viscose contents in the FR Viscose and Modacrylic blends (VM37, VM55 and VM73), HTI24 value also increase from 5.2 seconds to 6.3 seconds.

- Except fabrics coded as N, T, VT37 and VN37 all the samples are passing the passing the criteria of limited flame spread test as mentioned in ISO 11612 standard for protective clothing against heat and flame.

- The result of Multivariate analysis of variance (MANOVA) indicates that there is a relationship between FR-Viscose fiber content in the blends and LOI, RHTI24 & HTI24 properties.

**Acknowledgement**

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**References :**

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Influence of Elastomeric Finishing on Denim Fabric Properties

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2Garments Department, Faculty of Applied Arts, Damietta University, Damietta, Egypt.

Abstract
In recent years, increasing the demand for more comfortable garments enhanced the use of elastane-containing denim fabrics for casual wear. This study was carried out to investigate imparting new properties on denim fabrics using elastomeric finishing agent. Three types of denim fabrics; one is 100% cotton and the other two are cotton/elastane (Lycra) blends with different elastane ratios (2 and 5%), were treated with elastomeric finishing agent (amino-functional silicon macro-emulsion) using different concentrations (0, 10, 20 and 30 g/l) to evaluate the most appropriate concentration on denim fabric. The results revealed that elasticity, tensile strength, and elongation of the denim fabrics were considerably improved, due to the increase of elastane content as well as increasing the concentration of the elastomeric finishing agent. Furthermore, as the elastane ratio increased, the absorbency of the cotton denim fabric decreased, which imparts a sort of water repellent property.

Keywords
Cotton, Denim, Elastane (Lycra), Stretch garments, Elastomeric Finishing

1. Introduction
Today, a good design is not enough for garments. Garments should have good mechanical properties during usage. Elasticity plays a dominant role in the behavior of garments during wearing [1]. Cotton garments have very good properties such as water absorbency, comfort to wear and easy to dye [2]. Cotton garments with high functional properties such as elasticity, easy care, softness, antimicrobial, and self-cleaning have great demand in garments market [3]. Denim is a cotton twill woven fabric. It is popular among people of all ages. It is durable, and strong and due to its fabric structure. It is a woven fabric with dyed warp yarns and white weft yarns [4].

Today the most trend in denim garments is customer’s need with comfort, fit, flexibility, better dimension stability and special appearance [5,6]. Stretch denim fabrics add a comfort factor to work and casual wear [4,7].

Stretching performance is very important for the consumer comfort for some parts of body such as the knee, elbow and lower back areas. Garments are required to stretch comfortably in accordance with body movements, and to retain their original shape. Lycra fiber is the brand name of a class of synthetic elastic fibers known as spandex in the U.S., and elastane in the rest of the world. Because of its elasticity and strength, elastane has been incorporated into a wide range of garments, especially in skin-tight garments. Elastane is usually mixed with cotton or polyester, and accounts for a small percentage of the final fabric, which therefore retains most of the look and feel of the other fibers [7].

Adding 1.5% of elastane to cotton will stretch the fabric over the body providing a more comfortable fit. The ratio of elastane had a significant influence on the physical properties of woven denim fabrics [8].

Increasing the amount of elastane in denim fabric enhances comfort properties related to stretch. Core spun yarn can also be used as filling in which core part is Lycra filament and sheath fibers cotton, to improve the elasticity of denim [7,9].

Elastane fibers are a class of synthetic fibers compris-
ing at least 85% by weight of segmented polyurethane characterized by superior stretch and excellent elastic recovery properties. Core spun cotton yarns, with elastane component in the core and cotton in the sheath, have become quite popular in the textile industry. The elastane in the core yarn provides the necessary comfort for aesthetics wearers with good thermo-physiological characteristics [10].

A variety of raw materials are used to produce stretchable elastane fibers. These include pre-polymers, among which two react to produce the elastane fiber polymer back-bone.

One is a flexible macroglycol, such as polyester, polyether, polycarbonate, polycaprolactone which have hydroxyl groups (-OH) on both ends, these molecules are long and flexible so that they are responsible for fabric stretching characteristic. The other pre-polymer used to produce elastane is a polymeric disocyanate which has a shorter chain polymer and (-NCO) groups on both ends. These molecules are responsible for fabric strength as shown in Figure 1.

![Figure 1. Elastane chemical fiber structure showing flexible segments and rigid segments.](image1)

The ratio of the soft and the hard segment has a great effect on mechanical and elastomeric properties of the elastane fibers blended with natural fibers like cotton [11].

Elastomeric finishes are achieved with silicon-based products which often consist of a terminal silanol (\(\cdot\), \(\cdot\)-dihydroxy polydimethylsiloxane), methyl hydrogen silane and a metal salt catalyst. As the elasticity is durable, an alternative approach to providing fabrics with elastomeric finishes is to incorporate a few amounts of elastic fibers into the yarn of the fabric. Using of elastomeric finishes on fabrics blends with elastic fibers is common in textile industry. To understand the elastomeric mechanism, it has been reported that elastomeric finishing covers the fibers with a thin layer of an elastic material without fiber-to-fiber bonding [12].

Some hydro silane groups can be oxidized by air to silanol groups as shown in Figure 2.

![Silane and Silanol](image2)

Figure 2. Chemical structure of silane and silanol. Oxidization of hydro silane groups to silanol groups by air resulting in a silicon film as an elastomeric finish.

The resulting silicon film transfers elasticity because of this silicon film effect on hydrophilic fibers such as cellulose. Furthermore, the epoxy groups in silicon react with the hydroxyl groups of cellulose or the amino groups of wool and silk generating stable ether or amino bonds between the silicon film and the fiber surface [12,13].

Amino functional siloxanes, such as polydimethylsiloxane (PDMS) shown in Figure 3 is widely used in textile finishing.

![PDMS and Amino-PDMS](image3)

Figure 3. Chemical structure of polydimethylsiloxane (PDMS) and amino-PDMS as a siloxane emulsion used in elastomeric finishing.

Because of the interactions of amino groups with textile fibers, amino functional siloxanes are physically adsorbed onto the fiber surfaces as a thin film covering the fiber and increasing the fiber smoothness. The main disadvantage of Amino-PDMS is the yellowing of white or light-colored fabrics, due to the oxidation of primary amino groups by air, heat or light energy [14].
There is a growing need to study the finishing of denim fabrics, especially when elastane yarns are used in the production of the denim. The main aim of our study was to determine the influence of the elastomeric finishing at different concentrations on the properties of both twill woven cotton fabric produced from 100% cotton yarns and from cotton/elastane yarns. Elastomeric finishing agent based on amino-functional silicon macro-emulsion chemical structure is used in this study. The research work we undertook allows factories to improve the elastomeric properties of this popular kind of cotton fabrics.

2. Material and method

2.1. Fabrics

Three variants of twill woven denim fabrics were used for this study; Twill weaves such as three-up-one-down (3/1) and two-up-one- down (2/1) are predominantly used for denim construction, all the warp yarns are indigo blue dyed cotton, the percent of elastane in the blended denim is (2-5%). The specifications of the fabric variants are presented in Table 1.

<table>
<thead>
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<th>Denim (A)</th>
<th>Denim (B)</th>
<th>Denim (C)</th>
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</thead>
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<td>weave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>construction</td>
<td>twill 3/1</td>
<td>twill 2/1</td>
</tr>
<tr>
<td>warp</td>
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</tr>
<tr>
<td>weft</td>
<td>cotton</td>
<td>/spandex</td>
</tr>
<tr>
<td>%</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
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<td>320 g/m²</td>
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<tr>
<td></td>
<td>340 g/m²</td>
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<tr>
<td>warp/weft density</td>
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</tr>
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<tr>
<td>thickness (mm)</td>
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</tr>
</tbody>
</table>

2.2. Chemicals

Sodium hydroxide NaOH, wetting agent (triton X-100), acetic acid and anionic detergent were used for scouring and mercerizing, we used α-amylase for desizing. Special finishes were applied on pretreated fabrics using products, (Asumin Elast®), Modified poly dimethyl silicon amine (Amino-functional silicon macro-emulsion), supplied by ASUTEX, Spain. All chemicals are laboratory grade and used without any purification.

2.3. Methods

For pure denim fabric, as well as cotton /elastane denim blends, the warp threads are coated with a substance known as size or starch. It acts as a lubricant and protects the yarn during weaving. After weaving, the sizing agent has to be removed from the cotton fabric. Bio-desizing was carried out using α-amylase as follows: α-amylase 1%, Bath ratio 1:10, temperature at 50°C for 60 min, and pH at 6.0. After the enzymatic desizing, enzymes were deactivated by immersing the samples for 10 min in hot water (80°C), rinsing and washing in a solution of anionic surfactants at 80°C followed by air drying.

Amino-functional silicon macro-emulsion was used as elastomeric finishing by padding the fabrics in (10-30 g/l) Asumin Elast®, acetic acid for adjusting the pH of the finish bath at pH 5, pick up 60-80%, then drying at 150°C for 3 minutes and polymerization at 170°C for 1 minute. We compared the influence of elastomeric finishing with different pretreatment processes (desizing, scouring and mercerization) on the properties of denim fabric type A only, which is made of 100% cotton without elastane. For the comparison between the three denim fabric types in elastomeric finishing we chose bio-desizing, as it is the safest pretreatment for elastane and this is applied all over the experiments comparing the three denim fabric types.

2.4. Fabrics measurements

Each sample is tested in the standard atmospheric conditions, 25 ± 2°C temperatures and 65% relative humidity after conditioning for 24 hrs. The results were expressed as the average of five measurements. All the properties of raw and finished woven fabrics were measured in accordance with the following standards:

2.4.1. Shrinkage

The dimension changes in the weft/warp directions of the raw and treated fabrics were assessed. It is done according to AATCC 96-1997 method.

2.4.2. Fabric weight (g/m²) and thickness

Samples before and after pre-treatment were evaluated according to the standard ISO 3801:2003. Thickness was determined using standard test method for measuring thickness of textile materials ASTM (D-1777).

2.4.3. Tensile Strength and elongation

Breaking strength and elongation were tested on a universal tensile testing machine- Galdabini Quasar 50KN at the National research centre NRC, Egypt. Fabric samples with 25 mm x 150 mm dimension were
used. Tensile strength and elongation were determined according to Standard test method for breaking force and elongation of textile fabrics (strip method) ASTM (D-5035).

2.4.4. Evaluation of elasticity
Elasticity is described as the recovery property of a material after deformation. Textile materials cannot retain their original length when they are exposed to a force lower than their tensile strength. To what extent the material would retain its original length depends on the force applied, the duration of the application of the force, the duration allowed for recovery and the properties of the material. The recovery percentage of the material after deformation was calculated by the ratio of elastic stretching to total stretching [7]. We used the Young’s modulus of elasticity as an indicator of elastomeric finishes obeying the Hooke’s law which can be calculated with the following equation [15].

\[ E = \frac{\sigma}{\varepsilon} = \frac{F}{\varepsilon \cdot b \cdot d} \text{ MPa} \]

Where E is the Young’s modulus of elasticity which is inversely proportional to the fabric elongation, F is tensile force in N, \( \varepsilon \) is elongation (%), b is width in mm and d is fabric thickness in mm.

2.4.5. Water absorbency
The test for absorptive capacity and absorbency time were conducted following the principles of test described in ASTM D1117-80. Absorbency time is the time required for the complete wetting of a fabric specimen put on to the surface of the water from a height of the samples of 1-liter measuring glass cylinder, with a stop watch to record the time needed of the fabric to fully sink. For each sample five specimens were tested. Each specimen dimension was 20mmX 20mm. Specimens were tested in distilled water at 20°C. The time taken for the fabric to completely sink below the surface of the liquid was recorded.

3. Results and Discussion
3.1. Influence of elastomeric finishing on shrinkage of denim fabrics
Shrinkage of all raw fabrics is highest in both directions compared to the finished fabrics, for which shrinkage significantly decreased in the warp and the weft directions in Figure 4.

![Figure 4. Effect of elastomeric finishing concentrations on shrinkage percentage of denim fabrics. Comparing Shrinkage percentages in all desized denim fabrics.](image)

The shrinkage of 100% cotton denim fabrics after pretreatment was within the range of 1-2%. The shrinkage in the warp direction is lowest. The highest difference between shrinkage of fabrics with starch fabrics made of 100% cotton and fabrics including elastane. The values of shrinkage after finishing using different concentration decreased the shrinkage especially in the weft direction.

3.2. Influence of elastomeric finishing on fabric weight (gr/m²) of denim fabrics
The results of mass per unit area and change in weight (Figure 5) show that all treatments cause changes in the weight loss percent of the denim fabrics.
Figure 5. Effect of elastomeric finishing concentration on weight loss (%) of denim fabrics A, B and C.

Desizing with amylase enzyme causes reduction in weight, due to the removal of sizing additives up to the level of 1.9%. Additionally, Special finishes form a layer around fibers increasing the weight of the denim fabric represented as decreasing in weight loss percent.

3.3. Influence of elastomeric finishing on tensile strength and elongation of denim fabrics

In a biaxial woven structure two main directions are defined: longitudinal (warp) and transverse (weft) [15]. Because elastane was used in the weft direction, the assessments were carried out for only the weft direction. We observed that the tensile strength of the fabrics gradually increased with the elastane content as shown in Figure 6.

The figure showed that the tensile strength of the denim fabrics treated with elastomeric finishing was enhanced, especially denim C with the highest elastane ratio, maybe due to the fact that finishing made the fabric flexible and for this reason tensile strength was increased [16]. In addition, other studies revealed that silicon reduces abrasion, increases tearing strength and crease recovery [13].

These results are associated with the chemical and physical modifications of cellulosic fibers that occur throughout chemical treatment. As expected, the denim which included elastane in the weft of the fabric resulted in high elongation, as shown in Figure 7, and denim C was higher than denim B because it has more ratio of elastane.

Figure 6. Effect of elastomeric finishing concentration on tensile Strength N of denim fabrics.

Figure 7. Effect of elastomeric finishing conc. on Elongation % of denim fabrics.
3.4. Influence of elastomeric finishing on Modulus of elasticity in millipascal (mPa) of denim fabrics

Denim fabrics treated with amino-functional silicon macro-emulsion (0, 10, 20 and 30 g/l) as an elastomeric finishing are shown in Figure 8.

Since lower modulus of elasticity means higher elasticity [15], denim A showed the lowest elasticity (modulus of elasticity 9.79 mPa) compared to denim B and C which were 5.2 mPa and 4.23 mPa, respectively. These values were obtained with the highest concentration of elastomeric finishing (30 g/l).

This finishing agent chemical composition allows it to react with the hydroxyl groups of cellulose generating stable bonds between the silicon film and the surface of cellulosic fibers.

We also observed that the increase in elastane content affected the compressibility and compression recovery properties of the denim fabric samples. As the elastane content increased, fabric compressibility increased. This can be attributed to the spring like behavior of the elastane fiber and its tendency to return to its original dimensions after the load is being removed. The compression recovery of the denim fabrics also showed similar trend as compressibility. In addition, with the increased elastane content, the fabric thickness was increased [9].

3.5. Influence of elastomeric finishing on Water absorbency and repellency of denim fabrics

Figure 9 showed that as the elastane ratio increased the absorbency of the silicon finishing in all denim fabrics A, B and C decreased. This can be explained by the finishing agent composed of silicon imparting hydrophobic properties to the denim fabric, which is considered as a water repellent property [17,18]. The hydroxyl groups of cellulose in cotton fabric made the fabric hydrophilic, but after finishing with amino-functional silicon macro-emulsion, a thin layer of silicon was made onto the fabric, which prolongs the absorption time [16].

4- Conclusion

This study focused on the impact of elastomeric finishing using amino-functional silicon macro-emulsion, on the physical and mechanical properties of woven cotton denim and cotton/elastane blend. Elasticity of all denim fabrics after treatments was increased, due to the elastomeric finishing agent reacting with the hydroxyl groups of cellulose generating stable bonds between the silicon film and the surface of cellulosic fibers. Elasticity of the denim fabrics were increased,
due to the increase of elastane content as well as increasing the concentration of the elastomeric agent. The results revealed that mechanical properties of denim fabrics, such as tensile strength, elongation were improved after elastomeric finishing, due to the fact that the finishing agent makes the fabric more flexible, thus increasing the tensile strength of the fabric. This finishing improved the properties of denim fabrics.

References
Mr. R. N. Yadav

Mr. R.N. Yadav is having a wide experience in the Textile Industry of last 48 years’ service in Spinning & Composite Mills. He has started his career from the supervisory level and gradually with his skill and talent in work experience he elevated to the Mill President. He has occupied the independent top authority of Vice-President&then President during his last 34 years’ service.

Mr. Yadav worked with leading industrial houses like Bharat Commerce & Industries, Bhilwara Group, Mohota Group, Suryalata, Siddhartha and Jagdamba Group (Nepal).

Mr. Yadav independently started & worked successfully four new projects and renovated five mills. He established many new milestones in quality & productivity. He presented several papers in textile conferences and other meets affiliated to textile industries. He has 100+ technical & managerial papers published in textile journals and national dailies. Mr. Yadav is author of a hand book “Productivity” on strategic industrial management.

He is the recipient of Precitex award & Life Time Achievement award and Legendary Award from The Textile Association (India), M.P.Unit.

He is Patron Member, The Textile Association (India) and Life Member, Indian Environmental Association.

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MAINTENANCE ESSENCE

Introduction:
Good maintenance practices yielded enhancement in productivity in an spinning mill in middle India. Erection and commissioning of certain spinning and post-spinning machines were completed in record time. Reduction in time for any work increases productivity. Comparatively shorter duration of erection and commissioning didn’t only reduce cost of erection but made the machines productive earlier. As such productivity gain in terms of cost as well as production. In this narration, details of spinning ring-frame and winding machine Autoconer are presented.

Narration No. 1
A fact is being briefed here how time reduced during erection and commissioning process enhances productivity in case of a spinning ringframe machine from M/s. Lakshmi Machine Works Limited.

1). LR 6/S -1008 machine no. 90.
2000 was despatched from M/s.LMW,Coimbatore in four truck loads on 15th & 16th Sept.2000 by MetroRoadways.
2). All truck loads reached on mill sitecon 18th Sept.2000 night and were unloaded immediately on site.
3). Erection was started on 19th Sept.2000 morning at 8 AM by a 20person team of engineers, fitters and helpers. Commissioning of the machine completed by 7 AM on 20th Sept.2000 in a record time of 23 hours. Each and every procedural element during erection and commissioning was taken care of by 100 %. That the machine was made operational the very next day it reached the site of works.

The machine was run on 45's Ne count with following particulars:
Fibre used: Polyester 1D×40mm-50%Viscose1.5D×38mm-50%
Spacer size: 3 mm
Ring traveller: EM1UDR 7/0
TPM: 955
Draft: 31.55
Break Draft: 1.14
Cradle: Medium
Gauge: (centre- to-centre)
Bottom: 54 --60 mm
Top: 59--59 mm
Spindle speed: 12000 rpm (Running-in-Rings)

Yarn Test Summary:

Count (Ne): 45.57
C S P: 3801
Ct. C V %: 0.89
Test C V %: 2.33
U %: 10.64
Thin/km: 2
Thick/km: 10
Neps/ km: 41

Classimat Faults:
4). In general such machine is erected and commissioned in minimum 10 days by 20 persons working for 12 hours daily, that's 2400 man-hours. And the above machine was made operational in 460 man-hours only.

5). Thus the above machine yielded productivity by two ways
   (a). Man-hours engaged was less by 81 %.
   (b). And extra production for a minimum of nine days.

**Appreciation Letter from M/s. L M W:**
The detailed note attached under the heading 'Productivity Essence' complementing our product quality and service rendered which I am passing to all our factory personnel who have toiled and achieved the perfection in order to meet the customers expectation like you. I would like to congratulate you in organizing the team to execute and achieve the targeted assembly time.

Thanking you and with warm regards,
Yours sincerely,
(D. JAYAVARThANAVELU), Chairman & Managing Director, Lakshmi Machine Works Limited.

**Narration No. 2 :**
Schlafhorst Autoconer Model 338RM, Type 60 was erected and commissioned within 14 hours, a record time it may be.

1). The above type machine in container reached at site 7th November 2001 morning. Cases were unloaded, opened and the machine sections were moved on erection spot.

2). A total 13 person team of engineers, fitters and electricians started assembly works at 8 AM on 7th November 2001 itself and the machine was made operational by 9:45 PM same day in a record time of just 13 hours and 45 minutes.

   - **Speed**: 1000 metres / minute
   - **Drums / Operative**: 60
   - **Yarn run**: 1/45s P V: 50/50
   - **Efficiency**: 83%
   - **Breaks/100 km.**: 24

**Gauge Settings:**
   - **N**: 380%
   - **S**: 180%
   - **L**: 40%
   - **T**: 40%
   - **H1**: 370%
   - **H2**: 225%
   - **H3**: 100%
   - **H4**: 45%
   - **C+**: 18%
   - **C--**: 18%
   - **CC+**: 20%
   - **C C--**: 20%

3). In general such machine is erected and commissioned in 6 days by 8 persons working for 12 hours daily, that means 576 man-hours. And the above machine was made operational in 179 man-hours only. Thus the above machine yielded in following two dimensions.
   (a). Man-hours reduced by 69 %.
   (b). Production gain by a minimum of nine days.

**Classimat Faults :**
B1: 24, B2: 17, B3: 1, B4: 0
C1: 4, C2: 7, C3: 0, C4: 0
D1: 0, D2: 1, D3: 0, D4: 0
E: 0, F: 1, G: 0
H1: 9, H2: 0, I1: 0, I2: 0

**Yarn Test Summary :**
- **Count (Ne)**: 45.50
- **C S P**: 3710
- **Count C V%**: 1.06
- **Test C V%**: 3.83
- **U %**: 11.78
- **Thin / km**: 3
- **Thick / km**: 46
- **Neps / km**: 149

**Other Machines :**
In similar way drawing machines were erected and commissioned just within 8 hours. Cone winding and assembly winding machines too supplied in sections were also made functional within 8 hours after correctly erected and commissioned by the maintenance team. The only requirement for the above achievements is skilled and dedicated team. And the most important factor being confident and deter management.

**Expectations :**
Machinery manufacturers need to design and make machines in sections and that too, to be easily transported and simply erected. Also machines be user-friendly and nearly maintenance - free. Users be totally master of machine's design, functions and it's need to run it for optimum performance.
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 discussed the applications and the recent progresses of graphene and graphene-based materials in tissue engineering. To give better instruction into exploring potential applications of graphene-based materials for tissue engineering, the chapter had been organized in a property oriented structure. The chapter summarized and discussed graphene applications in the tissue engineering field based on their mechanical, electrical, chemical, and other properties.

The present chapter is the concluding chapter to this ongoing series. This chapter summarizes the conclusion and the future prospect of the Wonder Material - Graphene in the field of materials science.

Chapter 20

GRAPHENE A WONDER MATERIAL : The Conclusion

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

The wonder material graphene - an array of interlinked carbon atoms arranged in a single atomic thick sheet has promised a world of applications, including super-fast electronics, ultra-sensitive sensors and incredibly advanced materials. After a few false starts, that promise is close to realization. Furthermore, a suite of other extremely thin substances is following in its wake.

Graphene got its beginnings in 2004, when scientists at the University of Manchester found they could peel off a gossamer film of the material just by touching a piece of ordinary sticky tape to a block of purified graphite - the solid form of carbon that's mixed with clay and used as the "lead" in most pencils. Graphene proved stronger than steel inspite being extremely flexible, and electrons could zip through it at high speeds. It earned its discoverers the Nobel Prize in 2010, but researchers have been struggling years to manufacture it on larger scales and figuring out how its remarkable properties could best be used.

Today, graphene is finding its way into different types of products. Layered over zinc, graphene oxide (GO) is actively being developed as a replacement, with higher storage capacity, for the sometimes unreliable graphite now used in battery anodes. And nanotubes are recently being used as transistors to build a microprocessor, replacing silicon (unlike flat graphene, nanotubes can be coaxed into acting like a semiconductor). Though the microprocessor was primitive by modern computing standards, materials scientists think it could ultimately pave the way for more efficient, faster and smaller carbon components for computer processors.

At the same time, a new generation of two-dimensional materials is emerging. The success of graphene further fueled the ongoing effort to find useful atomically thin materials, working with a range of different chemicals, so as to exploit the physical properties that emerge in such super-thin substances. The newcomers include an insulator more efficient than conventional ones at stopping the movement of electrons, and another that allows electrons to glide across it at a good percent of the speed of light, with little friction. Researchers think some of these may one day replace silicon in computer chips, among other potential uses. Other materials now in development have even higher aspirations, such as advancing scientists toward one of the most tantalizing goals in chemistry - the creation of high-temperature superconductors.

Future prospects

It has become evident that the exceptional properties of graphene (including electrical, thermal, mechanical, optical, and long electron mean free paths) made it compelling for various engineering applications. Much
effort has been devoted to exploring the fundamental physics and chemistry of graphene. Novel properties such as room temperature quantum Hall effect, highest charge transport and thermal conductivity originated from graphene's 2-dimensional structures have not been observed earlier from most conventional three-dimensional materials. Large amount of research publications in the past few decades signifies the importance of graphene that might surpass silicon research in the development of microelectronics. While silicon-based research is at its mature stage to overcome the technological barrier, graphene is being extensively investigated as it holds the future for micro to nano scale electronics. The inherent semi-metal characteristics of graphene have been modified to realize the applications in transistors. Graphene nanoribbons and bilayer graphene are the results of such modification that leads to a suitable band gap and allows the applications in field effect transistor (FET).

Being hailed as the strongest material ever tested on this planet is impressive to say the least. Since its discovery and isolation in 2004, graphene has worn that title with pride, beating out everything from diamonds to steel - and winning Sir Andre Geim and Prof. Konstantin Novoselov the 2010 Nobel Peace Prize in Physics "for groundbreaking experiments regarding the two-dimensional material graphene". Due to the incredible demand across all industries for the strongest, lightest, and thinnest material, new and more efficient methods of production are in development. In the race for accessible and commercialized smart textiles, graphene appears in more and more technological innovations - and with good reason.

With the discovery came the knowledge of its many incredible properties, many of which will undoubtedly play (if they don't already!) into the future of smart textiles. These include:

Strength - As mentioned before, graphene is a "wonder material" - at 1 atom thick, its strength surpasses that of a diamond.

Conductivity - Proven to be more electrically conductive than copper, as well as thermally conductive, these smart textiles have the potential for wearables that are actually wearable. Coated fabrics are already being developed in the Cambridge Graphene Center that can withstand at least 10 washes. Potential applications range from garments monitoring vitals in either a medical, home health, or even military setting with cord free sensors placed directly onto the fabric, with thermal conductivity aiding in heat dissipation to "optimize electronic function", or even to track temperature of the wearer.

Flexibility - While smart textiles in their infancy weren't as comfortable due to use of stiffer conductive fabrics or other rigid technology, graphene's flexibility, low density, and weight make it easy to forget it's even there. The flexibility goes beyond the textile industry: Flexible OLED screen aiming for commercialization in the next 5 years; which could lead to bendable screens on garments integrating with the graphene equipped textile itself.

Water Repellency - At an atomic level, graphene is hydrophobic. Recent researches prove an "interesting relationship with water".

Biocompatibility - Being able to comfortably interact with the human body (or any other biological form) with no irritation is a major development in the smart textile industry. In fact, graphene is so biocompatible it is being tested as a potential bone implant material.

Transparency & Versatility - Graphene is the first 2 Dimensional crystal that has been discovered, making it as transparent and versatile as it is strong. Its integration into smart textiles developed for medical and military personnel can usher us into the next generation of wearables - "Invisible Textiles".

Energy Collection - Graphene not only sources, collects, and converts energy to electricity - but in the case of solar energy, can actually double it.

The applications of graphene in the smart textile niche - and across all industries - are just beginning to come to fruition, and the race to find effective ways to produce and bring these products to commercial market is full throttle.

Graphene dreams

For many years it was believed that carbon nanotubes would create a revolution in nano-electronics because of their microscopic dimensions and very low electrical resistance. These hopes, however, have not yet come to fruition because of various difficulties. These include producing nanotubes with well-defined sizes, the high resistance at the connections between nanotubes
and the metal contacts that connect them to circuits, and the difficulty of integrating nanotubes into electronic devices on a mass-production scale.

Walt de Heer argues that with graphene we will be able to avoid all of these problems. Using electron beam lithography it is possible to pattern graphene into electron waveguides, and to control its electronic properties by applying external voltages using electronic gates. Furthermore, unlike 1D nanotubes, graphene is a continuous medium and hence the heating associated with high resistance at electrical contacts is minimized. This kind of heating is essentially the limiting factor for the miniaturization of silicon microchips, so graphene is especially interesting for the electronics industry. Perhaps even more remarkably, graphene offers the prospect of carving whole processors out of a single sheet. Graphene research is still in its infancy and we wait to see what marvels it will produce in both fundamental science and technological applications. It is spellbinding to think that so many profound implications could come from a pencil and an adhesive tape. Indeed, the new field of graphene science illustrates well the remark of Ludwig Wittgenstein: “The aspects of things that are most important to us are hidden because of their simplicity and familiarity.”

**Summary**

This series of chapters dealt with the synthesis, fundamentals, and device applications of a wide range of graphene and graphene-based materials. In order to cover the multidisciplinary field of such diversity, the text has been divided into two major parts. The first part consisting of Chapters 1-6, deals with the history, synthesis, characterization and basic science of graphene, and their multidimensional/multifunctional derivatives. In the second part, Chapters 7-19 present an overview of graphene nanomaterials for various applications. The above approach will allow the readers to first review the scientific basis of such carbon nanomaterials and then extend the basic knowledge to the development, construction, and application of functional devices; many of them are of practical significance. The series has been explained to the readers in a very simple and lucid language keeping in mind of the readers who are new to this field. In the meantime, the large number of updated references cited in each of the chapters should enable our readers to quickly review the multidisciplinary and challenging field with information on the recent developments. Experienced academic and industrial professionals can use this series to quickly review the latest developments in this challenging multidisciplinary field and broaden their knowledge of carbon nanomaterials like graphene for developing novel applications in the field of materials science.

Finally, we wish to express our sincere thanks to Mr. Ashok Juneja - Hon’ble President of Textile Association of India (TAI), and his colleagues at TAI for their very kind and patient cooperation during the completion of this series named TEXNOTE, without which this series "Graphene A Wonder Material" would never have been appeared. We would also like to thank all of the chapter contributors, co-authors and our colleagues who contributed in one way or the other to this series. Last, but not the least, we thank our families for their love, unceasing patience, and continuous support.
Birla Cellulose launches Liva with added protection of Antimicrobial fibres, making Care Fashionable

Liva, the fashion ingredient brand from Birla Cellulose, part of Grasim Industries Ltd, Flagship Company of US $48.3-billion Aditya Birla Group, has launched Antimicrobial fibres, a breakthrough innovation that not only kills viruses and bacteria, but also inhibits their growth, keeping the fabric fresh and hygienic in the long run.

The latest innovation—Liva with added protection of Antimicrobial fibres by Birla Cellulose—is a leap forward in fashion by successfully injecting antimicrobial agent into Viscose Staple Fibre which when woven or knitted into a fabric offers protection to the wearer from bacteria and viruses, lasting over multiple washes while retaining comfort, fluidity and softness of the fabric.

Liva, the fashion ingredient brand from Birla Cellulose, is not just antimicrobial but also long lasting, while it keeps the fashion quotient high. At Liva, our aim is to make Apparels and Home-Textiles safe without compromising on performance and fashion.

Benefits
Developed using in-house technology by Birla Cellulose’s Research & Development team, antimicrobial agents are injected during the fibre manufacturing stage, making it an integral part of the fibre and providing durable antimicrobial properties. The science behind the technology involves the active agent being strongly bonded with the substrate, resulting in excellent durability to wash & wear. The interactions between cell membrane of the microbe and the active agent causes the interruption of all essential functions of the cell membrane and, consequently, the cell membrane gets ruptured and destroys the microbe. These agents inherently bond with fibres, resulting excellent durability to wash & wear and help retain antimicrobial effectiveness through multiple washes. This effectiveness is tested under stringent ISO standards and authenticated by International labs. Moreover, due to its nature-based origin, the fabric is skin-friendly. Killing of microbes inhibits odor development, keeps the fabric fresh and increases hygiene.

Liva with added protection of Antimicrobial fibres by Birla Cellulose, can be used in producing Menswear, Womenswear, Kidswear, Athleisure, Intimate wear, Accessories and in Home-Textile applications.

Traceability & Transparency for the Value Chain
Liva with added protection of Antimicrobial fibres by Birla Cellulose has a unique tracer in its fibre which helps in source verification at all stages of the Textile Value Chain and removes any possibility of counterfeit or dilution. Blockchain Technology based tool - Green Track™ is used to trace upward and downward value chain, to maintain authenticity of data.

For more information, please visit: www.birlacellulose.com | www.livafluidfashion.com | enquiry.liva@adityabirla.com
Due to COVID-19, a large number of spinning mills have stopped production worldwide. Since the end of March 2020, this has led to low demand for spare parts and wear & tear parts and delays in testing programs during the development of new machines. Customers are postponing investment projects or unable to implement them due to restrictions imposed by national governments. This results in low demand for new machines.

Comprehensive crisis management
Rieter has implemented comprehensive crisis management. Priorities are being given to protecting employees, fulfilling customer commitments and ensuring liquidity. The necessary measures to protect employees have been implemented worldwide. The order backlog of well in excess of CHF 500 million is being processed largely according to plan, despite the existing bottlenecks in the supply chains. Less than 5% of the orders in the order backlog have been canceled. Rieter has already implemented measures to ensure liquidity and reduce costs. The company has good net liquidity and undrawn credit lines in the mid three-digit million range.

Loss expected in the first half of 2020
As already reported, Rieter expects sales and earnings in the first half of 2020 to be significantly below the prior year level. The effects of COVID-19 will place an additional burden on the first half of 2020. Rieter therefore expects sales in the first half of 2020 to be less than CHF 300 million. Despite the countermeasures implemented at the net profit level, this will lead to a loss in the mid double-digit million range.

Implementation of the strategy
In recent years, Rieter has consistently implemented the strategy based on innovation leadership, strengthening the business in components, spare parts and services and the adjustment of cost structures. The company intends to forge ahead with the implementation of the strategy in the coming months, thus strengthening its market position for the time after the COVID-19 pandemic.

The next information on the course of business is planned with the publication of the half-year results on July 16, 2020.

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The COVID-19 outbreak is a human tragedy and has a growing impact on the global economy. The global pandemic has forever changed our behaviors as customers, employees, citizens and humans. Major issues faced by companies are total restriction on domestic and international travel, no customer contact and either cancellation or postponement of regular marketing activities and exhibitions. With these emerging new experiences, companies now have an opportunity to accelerate the pivot to digital platforms and to reimagine their digital strategies to capture new opportunities and digital customers.

To provide a solution to this situation, Blkrsna Media Events Hospitality has organized a Virtual Exhibition especially for the textile industry, The Blkrsna Virtual Textile Exhibition - BVTEX 2020 is expected to take place from 3 Sep 2020 to 6 Sep 2020.

Rajesh Padalkar, Principal Owner of Blkrsna informed "This is a perfect platform for every industry to get in touch with their customers from any part of the world. Even the visitors and potential buyers can be from any time zone on the planet. As no logistics are involved there is a huge cost saving in participation in such virtual events.

The 3D immersive environment gives the feel of actually attending a real exhibition. The Exhibitors can display their 3D machine models, interact with customers via text chat or with one-to-one video calls. The visitors on the other hand can be part of the trade fair without having to book flight tickets, visa, hotels and local transportation."

At BVTEX 2020 the Exhibitors can display their posters, brochures and videos, which can even be downloaded by the visitors. There is no restriction on who can man the booth. Out of the 3 persons designated to be on the booth, the first can be from Mumbai, the second can be from Coimbatore and the third can be a foreign Principal from any other country. The Exhibitors can even plan and cater to the demands of their customers from other time zones in the world as BVTEX 2020 is on for all 24 hours a day. BVTEX 2020 is also a good place for the visitors to connect with other visitors and network during the show.

Blkrsna is also open to the idea of Research Institutions tying up with their textile Principals and participate jointly to establish new business avenues and opportunities.

The textile industry has already reacted positively to this event. Mr Ashish Sharma, Vice-President-Marketing, Truetzschler India said "We are already familiar with the indusrtries 4.0 standards and BVTEX 2020 surely will take us a step further in the virtual world. It might not be a surprise if all future exhibitions are held virtually. We are looking forward to participate in this unique exhibition".

On the other hand, Mr K P Singh, Director, TeraSpin exclaimed "All other major exhibitions are either cancelled or postponed. Therefore, having a virtual exhibition is the best way to stay in touch with our customers".

Rajesh Padalkar smilingly also informed that "All other events being offered or planned are in the flat 2D format, while BVTEX 2020 is the only event at present offering the truly 3D virtual space at lesser costs. A visitor can actually enter the stall and move around having a closer look at items displayed. For example, if an Exhibitor had displayed a machine then the visitor can actually have a complete 360-degree tour around the machine".

Blkrsna wants BVTEX 2020 to be relevant to the textile industry and its end-users. They are always exploring new means to reimagine and to make its platform vital to all Exhibitors by offering an integrated sourcing platform. Blkrsna believes that all Exhibitors at BVTEX 2020 will be able to have meaningful interaction with their customers on innovative ideas that offer the end users a competitive advantage.

For bookings, the Exhibitors can fill up the form at https://blkrsna.com/contact-form and for other details and sponsorship matter they can drop an email at marketing@blkrsna.com
**Challenges of safe & healthy air-conditioning**

By Sunil Tiwari  
Vice President, Global Sales & Marketing, A.T.E. Enterprises Private Limited (Business Unit: HMX)

**What are the challenges of safe & healthy air-conditioning in COVID-19 times and how to meet them head on?**

It has been predicted by many that life will not be the same again post COVID-19. It holds true for every country across the globe. The most significant impact will be on the lifestyle of people. The things that were normal in pre COVID-era will no longer be considered normal, and there will be a "new normal" in place.

Air-conditioning, like many other facets of everyday lifestyle, is bound to change for sure. We have been hearing a lot from the HVAC experts on this subject in recent times - and ISHRAE, REHVA, ASHRAE and many other global associations of air-conditioning and ventilation engineers have published fresh guidelines for the safe use of air-conditioning in COVID-19 times. It is certain that these guidelines are here to stay for the future as well. Going forward, health and safety will be the primary criteria while operating HVAC systems or designing new systems, and "thermal comfort" will take a less important role. Let's take a look at what's been recommended by the experts mentioned above:

<table>
<thead>
<tr>
<th>Existing practice</th>
<th>The new normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>&lt;24 °C</td>
</tr>
<tr>
<td>Relative humidity (Rh)</td>
<td>50±10%</td>
</tr>
<tr>
<td>Fresh air</td>
<td>10 - 15% of total air</td>
</tr>
</tbody>
</table>

From among the three recommendations above, the single most important recommendation is the increase in fresh air ventilation in buildings. More fresh air will result in a higher number of air changes in buildings and thus will help in driving out contaminants and infectious particles effectively. While increased ventilation doesn't guarantee the elimination of risk altogether, it is the safest way to reduce the chances of spread of disease. And why only COVID-19, it applies to other types of infections as well, which are likely to keep growing in number with each passing year.

Let us remember that we have paid and are still paying a heavy price in the COVID times and so every measure that would help us to mitigate the impact of the dreaded virus must be adopted as soon as possible. Reducing infection chances with an adequate volume of fresh air in every air-conditioned space should be the top priority now, way above thermal comfort.

But this is easier said than done. Cooling of fresh air comes with a whole lot of challenges, and the immediate dilemma that air-conditioning users and the designers will face is the primary criteria while operating HVAC systems or designing new systems, and "thermal comfort" will take a less important role. Let's take a look at what's been recommended by the experts mentioned above:

The time has come to explore uncommon methods that have not been very popular in the past, or we may say, have been playing second fiddle to the prevailing dominant paradigm of refrigerated air-condi-
tioning. The technology of indirect evaporative cooling appears to be the unequivocal answer, and it can open up numerous safe possibilities in this new era. Let's take a look at this option more closely.

Indirect evaporative cooling, when coupled with direct evaporative cooling, and popularly known as 'two stage' or 'indirect direct evaporative cooling (IDEC)' is capable of providing the right amount of cooling, with the right kind of humidity, in 8 out of 10 places across the globe. For example, in India, barring towns located in coastal areas, for the rest of the geographies, IDEC is the answer to meet the room conditions of 27-30°C temp and 60±10% Rh. In the Middle East, the effectiveness of IDEC is even higher, and in some places, such as the central province of Saudi Arabia and interior regions of Kuwait, IDEC can provide year round comfort without any compromise. When it comes to cooling commercial buildings or industrial facilities in the safest way, IDEC is the optimum method - ensuring 100% fresh air and all this while keeping the energy consumption way below that of regular air-conditioning. For the places on the coast, which fall in hot & humid geographies, a modified form of IDEC hybridized with refrigerated cooling can be looked at as a healthy option, though it is a little more expensive in terms of capital expenditure than IDEC alone.

The most important role that indirect evaporative cooling (IEC) will play in future is in the safe pre-cooling of fresh air without using room return air. Integration of IEC in treated fresh air (TFA) units or fresh air handling units (FAHU) will help support the cause of increasing fresh air intake in buildings for adequate ventilation and making them safe. What's more, the IEC enabled TFAs or FAHUs are compact in size, economical and offer very attractive paybacks when compared to other energy recovery ventilators (ERVs). Due to simplicity in design, these can easily be retrofitted to existing fresh air handlers. Naturally, for an effective project, due care should be taken in selecting the right kind of equipment, and a thorough analysis of savings must precede the decision.

While there are several challenges awaiting us in the days to come, it is our duty to start planning in advance and evaluating all options including those which might have not been taken seriously so far. This paper is an attempt to explore the best possible options in the 'new normal', post COVID-19 scenario, for safe and healthy living, with the required level of comfort.

# Stay Safe, Stay Healthy

**Colorjet Group launched Oxyvent face filter brand**

Colorjet earmarks ?25 Million on technology for Oxyvent Face Filters launch amid pandemic crisis

Responding to the need in the market and to appease more people into wearing the face gear by making them more inclusive to everyday life, Colorjet Group has launched Oxyvent, a designer face filter brand in the market that comes with creative prints on it to amplify the aesthetics. As the masks become a necessity, the need to give the industry a new shape by making it fashionable and appealing to the masses forms the core of this new venture.

The face filters are unique adhering to safety standards and putting in creative design prints to encourage more people into wearing them. The products include Multilayer Safety masks made up with 100%
Cotton with 120 TC and melt blown material with moisture control anti-bacterial finish achieving a strict 95% Bacterial Filtration Efficiency (BFE). The designs are digitally printed on the fabric with Oekotex™ Approved Inks making the masks fit for human use and ecologically compliant.

At the Launch of Oxyvent Face Filters Mr. M. S. Dadu, Managing Director Colorjet Group said, "The vision to create a cloth based protection filter which provides superior filtration, yet being highly breathable was key to the innovation. As masks would become the essentials in the coming days, a fashionable yet fully functional air filtering mask is the need of the hour. We conceptualized a hand crafted fashionable necessity that provides safety while encouraging the fashion it has yet to set. Committing to our core design values of being Economic, Efficient and Ecological, we are using our own renowned International Digital Textile Print technology."

Colorjet has earmarked an initial investment of 25 million INR for the venture and is aiming at Printing 100,000 filters a day. The company has installed Direct to Fabric, Dye Sublimation, Direct to Garment and Laser Cutting & Finishing machines native to the group and in partnership with Japanese Technology for the project.

To bring in international designs and styles to life, Oxyvent has collaborated with renowned Web-2-Print workflow solution provided by Early Vision from Israel. "For mass customization of our designer face filters we needed an end to end workflow solution for our manufacturing. To achieve this we have collaborated with Guy Alroy of Early Vision as our pattern cutting solution provider because of its intuitive, easy-to-use tools and functionalities. Its insight into implementing Early Vision down the road, to enable efficient workflows for mass customization and on-demand manufacturing makes it the best in the industry. It will also minimize errors in communication with our partners, hence, saving time and costs." added Mr. Smarth Bansal - DGM Product & Brand - Colorjet.

For the print designs, the company has partnered with Emma Tranchini, a renowned Italian fashion designer and NitiSinghal, the native couturier of the New York Fashion Week fame where she displayed her range of apparels that were digitally printed on a Colorjet Textile Printers.

Oxyvent is also attempting at bringing its designer masks into corporate culture and has tied up with several leading brands in the market to customize the masks as per their branding needs. The whole range of products comes for men, women and kids, and can be explored at www.oxyvent.org

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BCI, CICCA, ICA, ICAC and ITMF are unified in promoting a common set of values and shared commitment to safe trading and contract sanctity across the global cotton community. Our joint challenge today is to ensure that fair and equitable trade practices govern the commercial relationships throughout the cotton and textile supply chains. We believe that these principles have never been more important than they are now.

The loss of demand resulting from COVID-19 and the preventative measures that are being applied throughout the world affects the cotton and textile sectors from end to end. It is essential for each trading partner to be mindful of each other’s position. We must strive to find mutual agreements which keep in mind our shared commitment to the long-term health of the international cotton and textile trade, and to the prin-
principles of fair and equitable trading practices on which it is built. We encourage that all those engaged in the cotton and textile value chains jointly and collaboratively commit to:

- Take actions that are considered and designed to contribute to the recovery of the cotton and textile sectors in 2021 and beyond
- Communicate, collaborate and be responsive to the needs of their counterparties
- Continue to respect the trade rules that govern the sectors
- Recognise and publicise positive behaviours. Identify and call out negative, counter-productive commercial behaviours.

The strong sense of community in the cotton and textile world will continue to be a source of strength. The constraints we are currently facing will pass and many of the freedoms that we are used to are likely to return before too long. We have confidence in the future of our industry.

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**Dr. Dhirendra Sharma promoted as Principal of MLV Textile & Engineering College**

Dr. Dhirendra Kumar Sharma has taken the charge of Principal, MLV Textile & Engineering College, Bhilwara (Rajasthan. He has been contributing towards the progress of the college for more than 27 years, in varied areas of administration, management and technical education. His expertise lies in developing network and raising funds, enhancing the learning environment, open communication with students and liaison with industrialists. Under the dynamic leadership of highly skilled, talented and qualified Dr. Sharma, the institute is leading towards achieving its goals of excellence in technical education.

Dr. Sharma had been instrumental in bridging the gap between industry and institute through The Textile Association (India). He is Honorary Secretary of the Textile Association (India), Rajasthan Unit since last 20 years and organized conferences and seminars of Industrial Importance under the banner of TAI, Rajasthan Unit.

Dr. Dhirendra Sharma has published more than 20 research papers in national & international Journals and Conferences. Dr Sharma has been awarded Young Scientist Fellowship by Department of Science and Technology, Government of Rajasthan, Jaipur in 1999. He has successfully conducted Training programmes for professionals and technocrats for the textile industry. His field of interest includes Textile Testing, Spinning and Technical Smart Textiles.

Dr. Sharma has been co-coordinator for RMAT-2011, CMAT-2012 and CMAT-2013, the Rajasthan State level centralized admission committee constituted for MBA programme. He has been in the panel of experts for various state level public service commission’s and AICTE.

It is hoped that MLV Textile & Engineering College will make exponential growth under the dynamic leadership of Dr.Dhirendra Sharma.

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**The creative approach to supercharge your brand**
DEVITA SARAF is the Cover Girl for Hello Magazine's June Issue

Devita Saraf, a new-age role model and businesswoman is this month's cover for HELLO Magazine. This Harvard-educated techpreneur started VU Televisions in 2006. The rare combination of beauty, brains and bravado is what has given Devita the edge to tackle her success with such elan.

She has put to shame anyone who says a woman can't succeed in a man's world. She's not just succeeded she's slayin it! She's taken VU Technologies from a tech-company to become a 1000 Crore revenue brand, with no signs of slowing down or stopping here!

"Indian women are incredibly intelligent, just like our goddesses, but we are always seen as the back-end strength, not front end as leaders, at least not in the corporate sphere. So I decided to be the face of my business," says Saraf. This thought-leadership coupled with her dynamism, versatility and ideas are bound to greatly change this world that loves its disruptors.

Always blending fashion and power, she is wearing a strapless pink dress from Solace London and Jimmy Choo shoes on the cover. This statement cover has been well appreciated on social media with over 40,000 likes.

The Textile Association (India) Visit us on www.textileassociationindia.org Follow us on facebook twitter linkedin

Journal of the TEXTILE Association May - June 2020 48
Loepfe announced today the appointment of Dr. Ralph Mennicke as Chief Executive Officer of Loepfe Brothers Ltd., effective from April 14, 2020. Ralph Mennicke takes over from Maurizio Wermelinger who, having joined Loepfe in 2007, became CEO in 2009 and is now retiring.

The Loepfe Board of Directors appointed Ralph Mennicke as CEO to lead the company and its subsidiaries. Loepfe is the worldwide leading manufacturer and solution partner for online quality assurance systems in the textile sector. Machine manufacturers as well as spinning mills and weaving mills around the globe use and rely on Loepfe technology from Switzerland.

Ralph Mennicke is a Graduate of Technical University of Munich, University of York, Mannheim and ESSEC Business Schools. He holds an MSc and PhD in Physics and an Executive MBA. Previously, Ralph Mennicke has held positions as CEO, Deputy CEO, General Manager and Product Manager, as well as interim Head of Technology, Product Management and Marketing. Since completing his PhD, Ralph Mennicke has contributed to technology, product and market expansion and acquisitions, as well as providing inspired and effective leadership during times of crisis in his previous company.

In his quest to set industry benchmarks and deliver quality improvement for customers, Ralph Mennicke has also been heavily involved in global standardization activities within the sensor and measurement fields.

Loepfe CEO Dr. Ralph Mennicke said: "Despite the current difficult business environment as I begin my role as CEO of Loepfe, my commitment to taking our business and our people on a journey where we will seek to grow and grasp future upsides has never been greater. As in my previous roles, at Loepfe my strategy will continue to focus on leveraging committed talents, superior technology and unique market knowledge to gain and maintain a competitive edge in the markets.

It is my very good fortune to be joining Loepfe from a company now experiencing a dynamic growth environment, and also to follow Maurizio Wermelinger who led Loepfe for more than a decade and established the company's reputation in the textile industry with some world-leading product brands. As well as Maurizio, I also thank the Loepfe Board of Directors and the Loepfe team for placing their trust in me to lead them through this tough period."

Loepfe Executive Chairman Alexander Zschokke commented: "The Loepfe Group extends a big thank-you to Maurizio for his long, loyal and successful lead of the company, as well as a very warm welcome to Ralph. We are delighted to have Ralph on board to steer Loepfe through the challenging phase arising from the COVID-19 pandemic, and beyond. Furthermore, we are confident that Loepfe is in a strong position to emerge from this time with renewed vigour and sustained growth."

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Whether standard or fancy, denim fabrics are in demand - but they are a low-margin product. That's why Stäubli offers specialized equipment for high-efficiency denim production. The broad range of machinery and systems covers production stages from automated weaving preparation to shed formation. With ultra-high weaving speeds and short downtimes, Stäubli equipment excels when it comes to efficient production in the competitive denim market.

The demand for denim fabrics in every format persists even during economic slowdowns. Denim remains highly popular; it is present in the collections of virtually every global fashion brand, from low-cost labels to top designers. To survive in the competitive world of denim weaving, the mill must optimize its process steps to save time, enhance quality, and maximize production. That's why Stäubli has developed a range of high-performance equipment for denim production.

Efficient processing of denim in the weaving mill

For easy start-up of drawing in, SAFIR features Initial Conditions Settings (ICS), options that adapt the machine's behavior to specific yarn characteristics such as coarseness or hairiness. Besides providing very high drawing-in performance, the broad SAFIR range allows maximum flexibility in terms of application and in the placement of the system within the existing space. It is easy to integrate into the mill because it can be optimally adapted to the material flows.

Once the prepared weaving harness has been linked to the weaving machine, the weaving process, based on the appropriate shed formation, can start. Crucial aspects of this step are downtime, yarn treatment, and especially the speed of the weaving machine, which must be coordinated with all other operating components, such as the shed-formation machinery. Here Stäubli shines again with its S1600/S1700 cam motion series and the dobbý range S3000/S3200 versatility in terms of pattern complexity. Continued research and development make the company offer ideally adapted and efficient solutions for continuous weaving - at a low total cost of ownership.
Cam motions are available with up to 8 (S1691 & S1692), and with up to 10 levers (S1781 & S1792), electronic rotary dobbies are available in 16-20-24 levers format.

This broad range of shed-formation machinery offers multiple possibilities for any application. The multi lever formats allow to applying stroke forces acting on the warp yarns through multiple frames and offer additional flexibility in terms of bindings. Most versatile denim qualities can be woven and allow the weaver to approach a broad market. Technical improvements make for ingenious machinery movements and support the frames, which results in delicate handling of the warp yarns. The advanced operational concepts result in a greater reliability during high-speed weaving and allow achieving unprecedented weaving speeds. Minimum maintenance requirements for the machine and the high quality harness motion, the link to the weaving machine - enhance further the high-performance operation of these shed forming machinery.

In Indian and Bangladeshi weaving mills, there are some 50,000 (India 40,000/Bangladesh 10,000) Stäubli shed-formation solutions (cam motions and dobbies) in operation. This significant presence illustrates the strong reputation of Stäubli’s machinery and services in the Indian and Bangladeshi market. Local teams cover the entire country to provide fast and dependable support whenever needed - and the availability of original Stäubli spare parts is ensured even years after purchase. Offering a full range of advantages, Stäubli is a proven partner for denim weavers.

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To increase system productivity and to keep service downtimes as short as possible, remote servicing has long been absolutely essential within a globally networked textile industry. For its Oerlikon Neumag and Oerlikon Nonwoven brands, the Oerlikon Manmade Fibers segment is offering a new secured remote service concept with defined loan-based hardware and software.

A remote connection with remote access to the systems creates entirely new service options.

A remote connection with remote access to the systems creates new service options that would not have been possible over the phone or by e-mail. With remote servicing, unplanned downtimes and the associated production stoppages, which can quickly result in costs running into the tens of thousands are significantly reduced.

Here, the standards for IT security and the requirements for IT components are becoming increasingly decisive. For these reasons, it is all the more important to ensure the requisite hardware and software are constantly up-to-date.

Upon signing a secured remote service contract, Oerlikon Manmade Fibers provides its customers with the necessary hardware and software, exchanges the hardware in the event of changes to security requirements and supplies continuous software updates. "Within the context of a secured remote service contract, we loan the hardware to our customers. This means that our clients do not have additional procurement costs and they do not have to worry about ensuring their technology is constantly up-to-date in terms of security requirements. We assume this task for them", explains Jan Pauer, Technical Sales Manager responsible for modifications, talking about the benefits of this service concept.

Secured remote service contracts are offered for all Oerlikon Neumag and Oerlikon Nonwoven systems and are available with additional, customerspecific services.

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Make more people aware of your brand and services
Home textiles directly influence the feelgood factor of our personal surroundings. Being pleasant to the touch, soft and extremely aesthetic, highly bulky upholstery fabrics for furniture, decorative fabrics and wall textiles, drapes and pleated curtains and even carpets can support and express our lifestyles and personalities. High-quality textiles for our beds, bathrooms and tables are frequently matter of fact for many of us. And high-end yarns are also used in the automobile industry for seat upholstery, interior cladding and floor covering in cars. Often, they have to withstand heavy demands. For this reason, the yarn quality of the high-titer yarns must be correspondingly high.

To date, DTY yarns up to 1200 den and with up to 784 filaments have, as standard, been plied from four POY 300d/192f bobbins using DTY machines. However, this process has a fundamental disadvantage: half of the texturing machine’s available winder positions are not used. And in terms of machine efficiency this is an unsatisfactory state of affairs. Here, Oerlikon Barmag offers yarn manufacturers a highly efficient solution: the spinning concept with WINGS HD 1800. This is made possible as a result of an additional godet, which ensures that the high yarn tensions developing in the process are reduced to the yarn tensions common in the case of the winding process to date.

At the same time, the newly developed suction unit with the accompanying yarn cutting device (yarn collecting system) ensures both during string up and in the event of a yarn break reliable handling of the yarn with an overall titer of 7,200 den (final) and 6,912 filaments.

With this, the Oerlikon BarmageAFK Big V Multispindle machine uses all winder positions and hence has the full production capacity at its disposal for manufacturing DTY yarns of 1200 den with up to 1152 filaments. Multiple plying of individually spun filaments to create a high overall titer fundamentally impacts yarn quality. With the Oerlikon Barmag concept, this is minimized by plying the highest titer possible.

**WINGS HD - superb efficiency and functionality**

Oerlikon Barmag concept comprising WINGS HD and eAFK Big V.

12 POY packages of up to 600d/576f (final) are produced in the spinning process using WINGS HD 1800. This is made possible as a result of an additional godet.

**eAFK Big V Multispindle - productive and yarn-gentle**

The eAFK Big V Multispindle texturing machine is based on the tried-and-tested eAFK Multispindle concept, with two individual friction rows. The high individual titer of up to 600 den per single filament can be textured using more powerful godet motors, a more powerful friction unit and a 2.5-m heater. The straight configuration of heater and cooling unit ensures particularly gentle yarn handling with a simultaneous drawing/crimping process. This is especially important for producing delicate microfilament yarns of the best quality. Thanks to this multiple configuration, 576 texturing positions can be efficiently utilized when manufacturing high-titer yarns, which are then taken up using all 288 positions. And the machine is particularly efficient in the high titer range of between 900 and 1200 den. Here, the operating window of between 30 and 1200 den offers yarn manufacturers maximum flexibility. The eAFK Big V texturing concept was launched in 2018, and has already convinced numerous yarn manufacturers with its performance.

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ITAMMA elected New Office Bearers for the period 2020-21

Indian Textile Machinery Manufacturers Association (ITAMMA) elected their New Office Bearers for the term 2020-21 during their Managing Committee Meeting held on 20-05-2020.

Mr. Chandresh H. Shah

Mr. Chandresh H. Shah is Executive Director of KRSNA ENGIMECH P. LIMITED - One of the leading & pioneer manufacturer of soft / over flow fabric sales head of KRSNA ENGINEERING WORKSs, manufacturer & exporter of all type washing range / bleaching range & finishing machinery he has been in to business of textile industry for last more than two decade & member of Indian Textile Accessories & Machinery Manufacturers Association [ITAMMA] for more than decade. His main motto to serve ITAMMA & its member for better business environment & help other small member to get maximum advantage from government scheme & subsidy. Apart from above KRSNA GROUP awarded twice by government of India for Environment friendly - energy saving machines for textile Industry also we are import substitute.

Mr. Dhijen R. Mehta

Mr. Dhijen R. Mehta is the Owner of M/s. Asht Green & Company Mumbai; which manufacturer's sewage effluent treatment equipment and related conveyor systems. Also the company manufacturers PIV chains and PIV gear boxes and a range of power transmission products. It is the Dealers of Diamond brand carding chains and all types of roller chains.

Mr. Mehta is also an Associate of the concern M/s. Transpro Engineering, the manufacturers of power transmission product, dealers and stockiest of worm reduction gear boxes and their spares.

Mr. Mehta is also an Associate of the concern M/s. Medh the manufacturers of special purpose food cutting machinery.

Mr. Mehta have been guiding and helping the Directorate in the management of ITAMMA’s Building activities leading to delivery of quality maintenance Projects at competitive cost, including state-of-the-art renovation of M C Ghia Hall.
Mr. Purvik Panchal is Technical & Sales Head of (SRT) Shree Ram Textile who Manufacturers a wide range of Warp Stop Motion for all types of Weaving Machines (Looms). SR Group is established since year 1957.

He is Partner of (SRE) Shree Ram Enterprise who are the Authorised Distributor and Importer of CNC Metal Cutting Machine, Cutting Tools, Oils & Adhesives.

Mr. Panchal has wide experience in Textile & Metal Cutting Industries for almost more than 15 years.

He is actively associated with ITAMMA since 2014 and in the managing committee since 2017.

Mr. Jugal Kishore is Managing Partner of Super Tex Industries - one the leading company manufacturing & exporting Textile Machinery Parts (Synthetic Rubber Cots & Aprons) in the world. He is also Managing Director of Yogesh Dyestuff Products Pvt. Ltd. - Manufacturer & Exporter of world class Acrylic / Cationic Dyes in the world.

He has been into the business of Textile Machinery Parts & Dyes business for almost 25 years & has been associated & a member of Indian Textile Accessories & Machinery Manufacturers Association (ITAMMA) for more than 15 years.

Mr. Jugal Kishore has main motto is to serve ITAMMA & its members for collective efforts & help members to increase their exports & resolve problems faced by them. Apart from the above he was also the President in his college & recently had been elected as the Vice President of Rotary Club of Mumbai, Western Elite.

The Corona-pandemic has revealed how extended the textile value chain is from producing fibres to the finished consumer products offered by brands and retailers around the world. Fibres can be produced in one country, yarns spun in another; fabrics are woven or knitted yet in another country before the final garment is sewn and shipped across continents.

The textile value chain is only as strong as the weakest link in it. It is important to realize that in a situation of global demand and supply disruptions, cooperation and dialogue are paramount for the entire supply chain. Our industry is facing demand shocks due to lockdowns around the world, which have posed enormous challenges to the retail industry. Passing the loss and pain to suppliers by cancelling orders cannot be the answer. To the contrary, cancellations will create even more problems by weakening the supply chain further.

ITMF and its national textile and apparel associations represent hundreds of thousands of companies and millions of workers across the globe. These companies
and workers cannot absorb the burden alone. ITMF’s recent Corona-Surveys have revealed that orders have plummeted by more than 40% globally and that turnover in 2020 is expected to be 33% lower than in 2019. The most pressing issue for most companies is liquidity. Therefore, it is essential that brands and retailers find solutions with their suppliers that allow them to pay their workers and avoid massive layoffs.

Responsible sourcing practices by brands and retailers are critical preconditions for socially compliant and eco-friendly production. Sustainability is not a one-way street; it can only be achieved, if stakeholders along the supply chain respect and treat each other responsibly.

ITMF was founded in 1904 and its members are associations and companies in the fibre, textile, apparel, home textile, textile machinery and textile chemical industry in almost 60 countries around the world, that are employing directly and indirectly millions of people.

Lenzing joins forces with Ruby Mills to fight COVID19
Leverages technology to manufacture sustainable antiviral fabric

Lenzing India and Ruby Mills Ltd have come together to present H+ Technology™ - for an antiviral, antibacterial and antifungal fabric. This breakthrough comes at a crucial time when India is facing an increasing number of cases. H+ technology’s efficacy has been tested and the findings successfully indicate that viruses and microbes won’t survive on the surface of the fabric that’s been treated with it - thus helping to arrest the spread of the virus.

Over the past few weeks, Lenzing and Ruby Mills have invested considerable time to put together a range of sustainable fabrics that has anti-viral and anti-microbial properties and doesn’t compromise on hand-feel, breathability & finish - which makes H+ technology fabrics unique. H+ Technology™ also works across a wide range of pure as well as blended fabrics. H+ Technology™ with LENZING™ ECOVERO™ and TENCEL™ means performance to finish on sustainable fibers.

At the very core of this technology is the active ingredient that kills over 99% of the H1N1 Influenza virus (the family of Novel Coronavirus) on contact and provides lasting protection for up to 30 washes, thus ensuring effective protection against transmission of virus.

Avinash Mane, Commercial Head - South Asia, Lenzing commenting on the development, said “Through this partnership with Ruby Mills, we aim to provide our citizens with the best possible protection through high-quality and sustainable products. We are working towards breaking the barrier that fabrics and textiles are carriers of diseases and viruses. At Lenzing, we believe in innovation and investment in technology to offer products that are high in performance and yet at the same time are part of the circular economy. Consumers can be rest assured that apparels with the tag of TENCEL™, LENZING™ ECOVERO™ and H+ technology™ will be safe to wear”.

Rishabh Shah, President, The Ruby Mills Limited commenting on the development, said "Most antimicrobial finishes have significant limitations - they become ineffective after multiple washes, and they hamper the fabric’s comfort and hand-feel. In our continuous pursuit for perfection and quality, we developed H+ Technology™ fabrics, by extending our processing expertise and know-how to ensure that the protection lasts wash after wash and the hand-feel, breathability and colour are not compromised.

We believe our H+ Technology™ fabrics have a wide range of applications across sectors and is significantly superior and most relevant in the times that call for heightened protection in everyday life.”

Creators of H+ Technology™, The Ruby Mills Limited has been one of the most respected vertically integrated textile mills known for fabric quality, consistency and innovation since 1917. Headquartered in Mumbai, listed on both the BSE and the NSE, Ruby Mills, aimed at enabling customers with H+ Technology™ and is working on bringing this to the consumers in collaboration with the Lenzing Group, an innovation leader, which stands for the ecologically responsible production of specialty fibers made from the renewable raw material wood. TENCEL™ and ECOVERO™.
Morarjee Introduces ViroShield Protective fabrics

Morarjee Textiles Ltd., a vertically integrated textile company manufacturing high-end products in prints, dyed and yarn dyed fabrics in a variety of substrates, has launched ViroShield range of protective finishes in collaboration with Australia-based Health Guard Corporation Pvt. Ltd.

ViroShield by Morarjee meets anti-viral efficacy of 99.99 per cent on all corona strains including COVID-19, as per ISO18184 anti-viral test and Bacteriostatic efficacy test ISO 20743.

The fabrics have a special chemical molecule which destroys the envelope cell wall of the virus, and as a result the virus dies. Thus, it helps in minimising the chance of re-transmission of pathogens by killing viruses and bacteria upon contact with the fabric.

"As a leading supplier of premium and niche fabric to the global brands, we bring the anti-viral fabric ViroShield from the house of Morarjee," said Mr. Harsh Piramal, Vice-Chairman of Morarjee Textiles Ltd.

ViroShield is compatible with all textile substrates and gives protection from droplets and fluids. In addition to being anti-viral and anti-bacterial, the finish is anti-odour, hygienic, skin compatible, non-irritating, and has no impairment on hand feel.

"In today's situation, safe and resistant fabrics are key to normal life, and we present the fabrics with anti-viral finishes in our ViroShield range," said Managing Director Mr. Rajendar Rewari.

The anti-viral finish on the fabric persists up to 30 home/laundry washes at 40 degree centigrade, the India-based company said.

Non-stop innovation in quality management

Why the tenth birthday of the USTER® QUANTUM 3 yarn clearer is worth celebrating

Ten years ago, it seemed like a ground-breaking innovation in yarn clearing technology. But that was only the start, and USTER's ambitions for its world-leading QUANTUM 3 series have never stopped growing. Spinners have been presented with a whole series of impressive developments - each one a big step in expanding the possibilities, from quality control at winding to 'smart' clearing, contamination control, mill optimization and even preventing faults from occurring at source.

"USTER®QUANTUM 3 featuring Smart Clearing Technology" was the headline in 2010 when USTER launched its third generation of yarn clearers. "It was an exciting time for me, introducing the first yarn clearer with automatic clearing limit proposals based on the Yarn Body concept," says Sivakumar Narayanan, at that time the USTER product manager for yarn clearing.

Powerful processing electronics made it possible for the system to display the full yarn body - an outline of the 'normal' yarn with its expected and tolerable natural variations.

Since then, the term Yarn Body has become a well-recognized and easily understood descriptor in the in-
dustry. Today, spinning professionals readily envisage the familiar green arrowhead symbol within a varying dark green frame as an essential element of the classification matrix.

Continuous development
This year, it’s worth celebrating the 10th anniversary of USTER®QUANTUM 3 - but not only as the ground-breaking third generation of a best-selling clearer system. What’s even more notable is its continuous further development during the past decade. Trailblazing progress in quality assurance technology now allows textile manufacturers to optimize production efficiency and reduce costs continuously, taking advantage of several beneficial extras with USTER®QUANTUM 3.

The development of Smart Clearing Technology, for example has been a massive leap, providing an indispensable tool for quality-oriented spinning plants. The new yarn clearer was a game-changer in many ways: it ‘learns’ everything needed about the running yarn in just two minutes, then - using built-in USTER knows-how - it proposes suitable clearing limits to achieve the required quality level. That means the same reliable quality level is achieved with contamination control for vegetable matter or polypropylene. Each issue is solved with a dependable clearing solution - even for severe problems such as periodic faults.

Once these highly sophisticated 'basics' were in place, USTER®QUANTUM 3 development focused on challenges with trend-related quality control, introducing two unique features in 2015. Irregularities in shade could now be detected and cleared in mélange and colored yarns, for better fabric quality. And the Core Yarn Clearing feature effectively eliminated the risk of fabric rejects through defective sections of these yarns - where the inner elastane component was either missing or off-center.

A 'grown-up' partner
As grown-up technology, USTER®QUANTUM 3 was ready to play a major part in all-round production optimizing. Yarn clearer data enables quality and cost to be balanced for best-possible profitability - and this is combined with data from USTER®JOSSI VISION SHIELD to achieve Total Contamination Control, with precisely-controlled contamination levels. "Our customers value the integrated solution to manage remaining contaminants in yarns at minimum possible cost," says Sivakumar Narayanan - in the meantime also himself 'grown-up' into the position of Executive Vice-President for Marketing and Business Development at USTER.

Extending the partnering of systems still further, the yarn clearer connects with data from USTER®SENTINEL to create the Ring Spinning Optimization Value Module. This offers optimization potential at the most costly stage in yarn manufacturing. For the first time, mills can intelligently correlate ring quality data and winding quality data in a single system. Smart alerts report deviations in ring spinning machines or changes in essential conditions such as relative humidity and temperature.

Smart, smarter...preventive
Still not satisfied, USTER product developers wanted to transform 'smart' yarn clearing into 'preventive' yarn clearing. The combination of USTER®QUANTUM 3 and USTER®SENTINEL creates a quality security tool, which stops off-standard quality yarn being produced at source, when the ring spinning optimization system is equipped with the Roving Stop feature. USTER®ROVING STOP effectively becomes a function of the ring spinning machine, just as the yarn clearer does in winding.

The appropriately-named USTER®RSO 3D adds a further third dimension - by providing individual cop quality data for each spindle position. Quality mapping along the ring spinning frame maximizes the optimization potential, while preventive measurements are in place at spinning and winding. Waste of raw material and cost-foolish cuts can both be managed preventively and automatically, thanks to a bi-directional exchange and analysis of data between USTER®QUANTUM 3 and USTER®SENTINEL. This benefit is enabled using USTER® QUANTUM EXPERT and Muratec QPRO EX/FPRO EX with Spin Inspector. Thus, the USTER®RSO 3D system achieves the ultimate goals of process optimization and traceability.

An impressive history over its first decade, but even more can be expected from the USTER® yarn clearer and 'friends' in future...

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Oerlikon Nonwoven delivering high-end meltblown technology

Protective Masks for Europe
Two companies newly-established in Germany to manufacture and distribute high-end protective masks were in the spotlight at the beginning of May: with FleeceforEurope and Lindenpartner, Düsseldorf-based Kloepfel Group purchasing consultancy and Berlin-based industrial consultancy Bechinger&Heymann Holding plan to manufacture and distribute up to 50 million protection class FFP1 through FFP3 respiratory masks a month exclusively for the European market from the beginning of fall. And the primary focus will be on quality. With protective masks - including those used in operating rooms - this quality is provided above all by virus-absorbing nonwovens. And these will be manufactured by the new venture 'FleeceforEurope' in Germany using an Oerlikon Nonwoven meltblown system.

But all masks are not created equally. For this reason, protection against infections such as corona-virus can only be guaranteed with the right quality. On the one hand, this relates to how the masks are made. On the other hand, it is above all -as is so often the case - about what's inside. Because the nonwoven used in protection class FFP1 through FFP3 respiratory masks plays a decisive role.

Here, the globally-leading and long-established meltblown technology from Oerlikon Nonwoven will be deployed. In a special, patented process, the fibers laid into a nonwoven fabric during manufacture are subsequently electrostatically-charged, before the material is further processed downstream.

Inquiries from all over the world

"Our patented electrostatic charging ensures that even the smallest particles, and therefore also viruses, are drawn in and absorbed by the nonwoven fabric for several hours. As a result of the comparatively loose formation of the fibers, the wearer can nevertheless breathe in and out easily", explains Rainer Straub, Managing Director of Oerlikon Nonwoven with pride. And rightfully so. Because Oerlikon is currently dispatching one meltblown system after the other. "We identified the situation early on and have adapted to demand. We started manufacturing in advance at the beginning of the year and can now start reliably delivering and quickly assembling systems."
And, due to our global Oerlikon Manmade Fibers segment network, we are able to offer the necessary service as well”, explains the experience engineer. Currently, the company is receiving inquiries from across the globe, but specifically also from Europe and from Germany itself.

"The Federal States all currently want to be self-sufficient in order to better control the so-called critical infrastructure in the future. The investment program announced by Germany's Federal Minister for Economic Affairs Peter Altmaier this week will additionally boost the demand for our meltblown technology”, continues Straub.

European market for protective masks with a promising future

Those responsible at Oerlikon Nonwoven and FleeceforEurope, which will primarily focus on producing high-end nonwovens, and Lindenpartner, which will manufacture and distribute the protective masks, are certain of one thing: the market for protective masks has a very promising long-term future in Europe. What has been commonplace in Asia for many years now will also become normal in Europe.

People will be increasingly wearing face masks when venturing out, in order to better protect themselves against health risks such as the current pandemic and also against increasing environmental pollution in the form of fine particles and exhaust fumes in the future.

"We didn't know what meltblown technology was three months ago. We helped our customers procure protective masks, at the same time discovering the in part hair-raising conditions in the global markets", explains Marc Kloepfel, CEO of the Kloepfel Group.

According to him, around 200 businesses in China were manufacturing protective masks until 2019, a figure that has meanwhile risen to include thousands of micro-producers. "And there is a lot of very poor quality on the market and, unfortunately, counterfeits as well.

But customers from all over the world are knocking on the door with bags of cash and buy everything they can get their hands on -even items that may have been stolen further up the supply chain. "The prices have practically exploded. "While masks used to cost ten cents to purchase, prices has risen to two euros or more during the coronavirus crisis", explains Philipp Heymann, CEO of Lindenpartner. However, there is - as in the case of many other industrial and consumer goods - a huge level of dependency on Asia, and China in particular, among Europeans and Americans. In order to become competitive here, the focus will be on state-of-the-art production processes for manufacturing protective masks. "At the end of the day, we will be able to manufacture products in Germany at Chinese prices as a result of our automation technology", explains Heymann.

Medical face masks from a vending machine

Mask producer Lindenpartner has already secured supplies of nonwovens and will be producing face masks for the European healthcare sector over the coming weeks. To fight the coronavirus pandemic, Lindenpartner is planning to install 100 self-service face mask vending machines in Germany over the next four weeks, positioning them in publicly accessible places such as shopping centers and airports, for example. FFP2 masks will initially cost around five euros from vending machines. As soon as Lindenpartner is able to manufacture the masks with its own nonwoven fabrics, prices will fall to approx. 2 to 3 euros.

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Since the outbreak of the coronavirus pandemic, the worldwide demand for protective masks and apparel has resulted in a record number of new orders in the high double-digit millions of euros at the Oerlikon Nonwoven business unit of the Swiss Oerlikon Group. From the manufacturing site in Neumünster, Germany, the high-tech meltblown systems - with their patented ecuTEC+ nonwovens electro-charging technology - are meanwhile being exported all over the world. For the very first time, a contract has now been signed with a business in Australia. Today, Schleswig-Holstein's Minister President Daniel Günther was won over on site by the technology of a 'global player'. Rainer Straub, Head of Oerlikon Nonwoven, was thrilled, stating: "The machines and systems for manufacturing manmade fiber and nonwovens solutions from Neumünster enjoy an outstanding reputation throughout the world. It is especially in this crisis that the technology from Schleswig-Holstein has proven itself to be absolutely world-class."

"As a result of our additional investment at the site here in Neumünster - be this in our new technology center that will be completed by the end of this year or in our new logistics center that is already operating - we, as one of the region's largest employers, are continuing to move forward, supported by a State Government that is also focusing on both promoting industry and business and on advancing an efficient training and educational system, as innovation is only possible with outstanding engineers", stated Matthias Pilz. And Rainer Straub directed his appeal specifically at the Minister President: "Treat education and training as a priority. Ultimately, they will secure the future of Schleswig-Holstein as a center of excellence and manufacturing!"

In addition to a tour of the meltblown system and its assembly and production facilities, the visit by Minister President Daniel Günther had one purpose above all: the dialog between politicians and business. Rainer Straub, Head of Oerlikon Nonwoven, and Matthias Pilz, Head of OerlikonNeumag, jointly expressed their thanks for the support that Oerlikon has repeatedly had the fortune to experience over the past months and years in Schleswig-Holstein and looked to the future full of hope.

Daniel Günther, the incumbent Minister President of Schleswig-Holstein since 2017, immediately responded, making reference to one of the Federal State's current training initiatives: "The State Government is support-
ing higher education institutions and students in the present coronavirus crisis. With a five-million-euro digitalization program, we are investing on the long-term digitalization of our higher education institutions. With this, we are overall creating a future for young people, particularly also for those who could very well go on to invent the next generation of manmade fiber systems."

And the Minister President was just as impressed by the willingness and readiness with which Oerlikon has been providing high-level support since the beginning of the COVID-19 pandemic to master the present challenges as he was with the company's meltblown technology itself. Rainer Straub explained: "When, at the beginning of the pandemic in February, demand for protective face masks increased rapidly, we at Oerlikon Nonwoven responded immediately. We ramped up all the available production capacities here in Neumünster in order to quickly manufacture nonwovens for producing face masks using our laboratory systems.

As a result, we have been able to make a small, regional contribution to covering demand. In parallel, we have pulled out all the stops in order to systematically further expand our skills as machine and system builders so as to cater to the initially expected, and now also continuing, global demand for meltblown systems as quickly as possible."

Leading meltblown technology
The Oerlikon Nonwoven meltblown technology - with which nonwovens for protective masks can also be manufactured, among other things - is recognized by the market as being the technically most efficient method for producing highly-separating filter media made from plastic fibers. The capacities for respiratory masks available in Europe to date are predominantly manufactured on Oerlikon Nonwoven systems. "Ever more manufacturers in the most diverse countries are hoping to become independent of imports. Therefore, what we are experiencing in Germany is also happening in both industrialized and emerging countries throughout the world", commented Rainer Straub. In addition to China, Turkey, the United Kingdom, South Korea, Austria and numerous countries in both North and South America, Australia and not least Germany will for the first time also be among the countries to which Oerlikon Nonwoven will be delivering machines and equipment before the end of 2021.

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KARL MAYER

STOLL transferred to KARL MAYER

With the so-called closing, the merger of the two world market leaders, KARL MAYER and STOLL, was officially completed on 1st July 2020. The relevant agreements were signed on 26th February 2020, thus, setting the course for the formation of a trans-technology global player, who changes the world of its customers and of the textile sector.

KARL MAYER is now the leading provider of solutions for the two most important stitch-forming processes, flat knitting and warp knitting. The company's entire expertise in the fields of warp knitting, flat knitting as well as technical textiles, warp preparation for weaving and digital solutions is now housed under one roof.

When it comes to the manufacture of products for warp knitting, warp preparation for weaving and the
areas of technical textiles, KARL MAYER is innovative market leader with more than 2,300 employees worldwide. STOLL, the international sector leader with roughly 1,000 employees, stands for progressive tools and services for tomorrow’s knitting.

STOLL will continue its activities within the KARL MAYER Group as autonomous business unit. The brand will be carried on independently, and represents KARL MAYER’s expertise in the field of flat knitting technology. KARL MAYER also relies on STOLL’s proven management. The previous CEO, Andreas Schellhammer, will become President of the STOLL business unit within the KARL MAYER Group.

"With STOLL’s excellent know-how and committed staff, we can build on a good basis for further joint developments.

STOLL and KARL MAYER complement each other perfectly in terms of technology, they consistently rely on the proximity to their markets, and they are the innovation leaders in their sectors. The merger offers the basis for new machine-based solutions, textile products and digital offerings, which will make a major contribution to strengthening our customers in their business environment”, says Arno Gärtner.

In the area of machine development, it is possible to use completely new technological principles but also optimizations of details, for example concerning the operation. For the development of new textiles, the customers can rely on broad, cross-sector expertise. They can benefit from the Group’s entire textile-technological know-how in the fields of warp knitting and flat knitting with an even increased application-oriented focus. The customers contact persons will remain the same.

One of the main aims in production is to increase the added value for more know-how protection, flexibility and rapid delivery. Components from own production will be used groupwide, if possible, and the manufacture of the STOLL machines in China will be integrated into KARL MAYER’s location in Changzhou. With a surface area of 90,000 m² and modern factory halls, the Chinese plant offers the perfect conditions for continuing STOLL’s high-quality production. The integration project runs smoothly, despite highest complexity and corona pandemic. "The teams from STOLL and KARL MAYER are full on schedule. They cooperate closely and extremely dedicated, they complement each other’s strengths, and successfully live the merger”, explains Andreas Schellhammer.

Moreover, via their familiar contact partners, the Chinese customers can rely on the resources and organization of KARL MAYER (CHINA) in the fields of service and spare parts. The spare parts are manufactured in-house, they are stored in larger quantities, and dispatched directly from China to China. This ensures shortest delivery times.

In terms of digitalisation, the know-how merger raises expectations for innovation leaps with advantages for the customers and effects on the entire textile industry. KARL MAYER’s KM.ON is a highly agile software start-up, that uses the potential of cloud-based concepts and of artificial intelligence for completely new digital solutions. STOLL offers many years of experience in the software section. Together it will be possible to accelerate digital product developments enormously.

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Clouds of Corona are slowly fading away & so let us be ready for a brighter "post corona era".

Before getting started with full fledge productions, many mandatory things are coming our way.

There would be certain norms, business ethics & good work practices needed to be followed, in order to make ourselves compliant for post corona manufacturing process.

Suvin coming up with personalized online solutions to tackle the challenge in post COVID 19

To tackle the challenge up ahead, Suvin are coming up with personalized online solutions based on:

- Best Architectural practices in line with COVID 19 norms
- Modifications to be carried out in the existing systems

All these solutions will be crafted taking into consideration that no major changes are re-carried in the existing setup. This means Suvin will utilize the existing production layouts as they are, by suggesting improvements based on post corona compliance. Resulting into clean production units.

Suvin is ready to render their smart services to enable for more sophisticated.

What Suvin will need?

Existing AutoCAD Drawing | Workers/employees list | Existing Setup Photos

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Strategic transformation underway at Loepfe

Loepfe Brothers Ltd. announced today its intention to restructure and refocus its business over the next three months in order to align with the changed market conditions and to further leverage digital technologies. Plans to release the next in a series of new solutions in Quarter 4/2020 remain unchanged.

The business will be transformed in the medium- to long-term by diversification, expanded business portfolio and increased efficiency along with an accelerated digitalization program.

Among the organizational changes made to support these objectives will be an increased emphasis on customer needs driven by SilvanoAuciello as head of a new combined sales and customer support setup. In a move to strengthen the focus on products and solutions, Guido Wieland becomes responsible for leading a joint product management, applications and marketing team. Furthermore, Sylvie Hunziker has been appointed to drive and shape the digital landscape and processes within Loepfe, next to her already established lead of the production department. Meanwhile, as announced in May, the R&D team has already been supercharged by the appointments, as joint heads, of Thomas Schlegel and Roger Hilzinger, capitalizing on their deep specialist know-how and experience to ensure the flow of latest technology products through the pipeline. Further internal changes aim at reinforcing Loepfe’s high Swiss quality standards across the whole product range.

Loepfe CEO Dr. Ralph Mennicke commented: “We live in a world where change is a standard feature of our lives. It is important that we embrace and actively drive these changes by continually questioning things and redefining our offering to harness the benefits of the fast-moving environment for our customers and our business. My thanks go to each of the aforementioned for taking up the new challenges along with our teams, and I look forward to our exciting journey together.”

Loepfe Executive Chairman Alexander Zschokke added: “With this announcement today, the Loepfe and Savio Groups are investing not only in our business, but also in our people. The work they are now undertaking will future-proof the company and ensure it remains the leading specialist in its field for many years to come.

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In today's uncertainty, starting a new business or value addition/expansion to the conventional business needs to be done with a great amount of care and with thorough investigation. However, crisis always opens the doors for new opportunities. Let us understand the top segments of technical textiles which would be serving the immediate needs of the world.

Looking at our country's strengths, we feel the following segments would be the most beneficial & feasible:

1. **Medical Textiles** - Nothing surprising here the current situation has already seen the growth of this sector. Once major importer of PPE kits today India is not only meeting its own requirement but also exporting to large extent has become one of the prominent players in this sector. We feel the right type of products which can serve appropriate quality norms will be the need of the hour.

2. **Hygiene Textiles** - The COVID-19 pandemic has opened a wide door for this sector & it has today acquired the status of prime necessity. Especially "untouched" "disposable" and "use and throw" products like napkins, wet wipes, de-makeup pads will find a big space in consumer market.

I feel, wet wipes with soap solution will easily be a substitute to washing of hands as they will reduce water consumption drastically.

3. **Sportswear** - With the growth of Athletics & fitness industry, sport textiles will soon be the essential requirement by a major population of our own country. Especially the Post Covid era will see far more people attracted to the fitness regime with social distancing. It would be more of indoor fitness activities and in house gyming.

4. **Industrial Textiles** - Looking at the growth of India's manufacturing sector and with our PM's vision of "Atmanirbhar Bharat". Industrial textiles will be the key segment with huge potential having requirements for products like filters, protective wears and other industrial products like conveyor belts etc.

Another aspect is to switch over to new products by replacing the current woven & knitting lines. Convert use of conventional textiles by using innovative technical textiles.

5. **Food & Grain Baskets** - With nonwoven efficient packing material will not only reduce the current wastage of about 40-50% acquired during movement from farm to consumer, but also will be a much cheaper substitute for bulk production and quality goods. More emphasis would be given to environment friendly products. We can think of natural fibres being used in this sector. Moreover, waste recycled material may find quite a bigger share in this sector.

6. **Disposable Curtains** - The curtains used in hotels. Most of them are not replaced for years as they are highly priced - elegant products produced using woven jacquard technologies. Now with current pandemic, importance of hygiene is at peak. So if we produce these curtains as disposable curtains that can be replaced on monthly basis or so. The life of curtain is reducing but at the same time the disposable curtains are priced almost 1/10th of the jacquard curtains.
Hence, we can give variety of products with changing aesthetics of hotels/restaurants etc.

7. Automotive Textiles - The safety feature will drive this sector in coming future. The post pandemic era will be aiming on reducing the flooded public transit. Thus an increased demand of vehicles will be met by in-house productions of automotive textiles to bring down the overall cost of imported products. Even seat covers, cushions will be needed to replace as well as washed on regular basis.

8. Agro Textiles - Agriculture being the backbone of economy, use of agro textiles on account of its benefits for fresh produces with better productivity will be another sector to look on. People will demand for garden fresh food than frozen goods. Moreover, land area cost is increasing day by day. Atmanirbhar Bharat will also a factor to be looked into. To meet these requirements, we need to harvest more in the limited resources. Agro textiles will help in this regard in addition to water saving measures.

9. Geo Textiles - Being a developing country with a focus for strong manufacturing base, the government's immediate focus will be on increasing the connectivity & reducing transit time. This will demand toll of improvements in the existing roads & many new highways. Also more water canals with water saving techniques are already planned by Indian Government. Many more will be built up in near future, all leading to the growth of geotextiles. Products like geo-grids, geo-nets & geo composites would be the need of the hour. Moreover, Chinese products will be discouraged for known reasons hence we can have import substitutes.

10. Even with above generalized assumptions of profitable products all new entrepreneurs need to assess themselves based on their inherent capabilities, marketability, knowledge of the technology, location of operation, sourcing of raw materials & convertibility into finished products.

Though the technical textiles are growing with a CAGR of 12-15%, there needs to be market study to identify the products to be manufactured, market potential in coming years & by doing competitors analysis.

Suvin needs to find answer to general questions like:
Can we convert existing business products into finished products?
What are my requirements?
What is my USP?
How can I be more competitive in coming years?
Which are my weaknesses I need to win over?

Only by researching answers to all these questions an entrepreneur will be able to choose the right product basket for his business.

Be unique… what works for others might or might not work for you!!!

Business is already filled with uncertainty. It is time to reduce the level of certainty with in depth market research of the subject.

We as expert textile consultants can help you tackle the challenges up ahead with market & technology research. Explore professional help through our in house research wing and technology awareness.

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People all over the world: USTER's valued assets

After-Sales Service factors in key benefits for customers

For USTER customers, superb support is always at hand. With more than 225 qualified engineers and technologists in its four regional and 29 local service centers, USTER has the world of textiles covered. Its expert teams ensure that every piece of equipment is installed perfectly and running smoothly. But that's only the start: throughout the long lifespan of the instruments, service teams are ready with rapid technical assistance, even in locations that are in the more remote areas. Some of these dedicated support and service providers are introduced here.

Support is delivered both locally and remotely, including software updates as well as practical advice in the customer's own language. Know-how transfer at the local level is enhanced through reliable and friendly service contacts. "Our After-Sales Service operation also follows the USTER 'Think Quality' approach, to ensure confidentiality and maintain product value," says Suresh Kris, Vice-President Global After Sales & Service, Uster Technologies.

Ultimately, it's the people who make the difference with USTER After-Sales Service. They represent teams based in every textile market, all over the globe, some of which are featured in this article.

They, and all the others, continue to provide support wherever and whenever needed - a fact proven even more strongly during the current pandemic crisis.

Success factors

A very ambitious team works at CATEC. USTER's service and sales agent in Egypt since 1994, this organization has earned over 40 technical credentials, engineering awards, top ranking positions in USTER programs and a certificate of excellence in local service station performance monitoring in 2017. "Our aim is to
exceed customers’ expectation and we are convinced that profound knowledge and expertise are one way of doing so. Therefore we take part in the wide range of seminars and training courses offered by USTER," says Eng. May Ragab, USTER Agency Manager for CATEC.

She is the driving force behind these achievements, working with USTER for over 25 years: her work is her passion, CATEC her home and the team her family. It also feels like a family to Tarek Ibrahim, who joined as Service Assistant Manager in 1996. Discussions within the team are extremely valuable in seeking the best solutions for customers.

Mutual interaction within CATEC is also deliberately focused on encouraging team members to progress their personal and career development. In Ibrahim's case, this included achieving a master's degree in industrial engineering.

CATEC services go beyond the expected. Customers especially appreciate the fact that quality data is checked onsite - even when there is no apparent issue - to optimize quality improvement and production efficiency. "I like to apply my knowledge in both service and textile technology fields, helping to achieve the next step of quality optimization," says Ibrahim. CATEC also provides high-quality training courses for customer personnel and complementary application seminars to assist on site. "We teach our customers regardless if, or when, they will buy. That's why we are ranked for the highest service standards in the market," says Ibrahim. It's no surprise that he and his colleagues are often called to visit mills outside their own country if another service organization temporarily needs an additional team member.

Customer satisfaction factors

After-Sales Service is seen as a powerful plus for sales by Kim Kim, General Manager of PT Gansa Techno Center. That was the reasoning behind the establishment of a solely service-focused company for USTER in Indonesia in 2006 to support the sales organization PT. AGANSA PRIMATAMA, where he was appointed Spinning Division Manager.

Kim Kim's work with USTER products spans 14 years - actually a typical depth of experience among these service specialists. His team of technicians, textile technologists and technical managers has between 6 and 23 years' experience with USTER products. They also regularly attend a range of training programs, building on a solid background of electronic and industrial technologies, as well as IT (hardware and software) and textile knowledge.

This degree of profound know-how and long experience were invaluable to Technical Manager Adi Setiawan and also to a customer in Malaysia. When he arrived from West Java, Indonesia with everything prepared for service and calibration work, Setiawan identified other issues which needed attention with higher priority. The customer's assumption was that 'service' included total repair - restoring everything to newly-installed condition. "My colleagues and I, we are used to accepting these kind of surprises as individual challenges," says Setiawan. In this case, they used the limited time to make the equipment run at its best again, and thanked onsite staff for their support, good communication and relationship which made it possible. Nevertheless, everyone at the customer was aware of the capability and proficiency of USTER service technicians and they were impressed how they responded quickly, fixing some problems immediately and providing a working solution for other issues until new spare parts could be delivered to effect a permanent repair.

Long-standing relationship factor

One hundred percent dedication also applies to staff at Rauf Electronic Equipment Service, the authorized service station of Uster Technologies in Pakistan for 55 years. Its full range of after-sales services delivers customer care which is individual and comprehensive, as well as customizable. USTER®9000 after-sales and service plans are tailored for those customers with ISO 9000 certifications, where frequent accuracy and calibration checks of instruments are mandatory. USTERIZED® clients also have a subscription for USTER®9000 services.

The team at Rauf Electronic Equipment Service (28 Field Service Engineers and 22 Technicians at the workshop) secures a 24/7 service. Their high engagement - sometimes really hard work - has established a strong relationship with customers based on trust. Attending trainings but also on the job they gain valuable knowledge of modern textile technology as well as of industries IT.

USTER services help customers achieve and maintain
top performance from their instruments throughout their lifecycle. "Optimal performance isn't our prime goal. We go one step further for our customers, aiming for maximized profitability through greater efficiency," says Abdul SamadAmiwala, Partner and Executive Director atRauf Electronic Equipment Service. The company's service technicians can access the entire range of USTER textile know-how, which is at the disposal of customers, helping them to make their processes more efficient and their final products superior.

Cooperative factor
"Our goal is joint success with the customers," says Kris, who is in charge of USTER's global After-Sales Service. "This cooperative focus is what defines us and motivates everyone involved - in the workshop and in the field. I'd like to take the opportunity to thank our staff for going the extra mile in many aspects every day."

Loepfe increases its backing of the electronics industry. The latest projects in China and Taiwan underline the importance of reliable quality control of demanding technical fabrics. Loepfe's unique WeftMaster FALCON-i will be integrated into two of the world's largest manufacturing lines of PCB boards.

Printed circuit boards, or PCBs, are used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. Used in quantities of millions, in 2018 the Global Single Sided Printed Circuit Board Market Analysis Report estimated that the PCB market would reach USD 79 billion by 2024.

WeftMaster FALCON-i - New projects in China and Taiwan

PCBs are generally made of various layers of materials, which are bonded together by heat, pressure and other methods. Its basis, the so-called substrate, is commonly made of glass epoxy, also known as fiber reinforced plastic. In order to ensure and achieve an efficient and smooth PCB manufacturing process, a top quality and flawlessly woven glass fabric is the key to minimized rejection costs and ultimate quality assurance.

A fully integrated PCB manufacturer can control the entire manufacturing process. One of the world's largest manufacturer of such boards and other technical glass fabrics, operating several plants in China and Taiwan, occasionally experienced tiniest unevenness on the surface of its PCB boards. Particular defects originated from exactly that woven glass fabric, eventually caused by minute filamentation of the yarn and slightest fluff accumulation during the weaving process. By using FALCON-i optical sensors to monitor the weft insertion during the weaving process, such tiny yet costly defects could easily and reliably be eliminated.

In order to detect even the tiniest yarn irregularities FALCON-i offers extensive sensitivity levels, allowing customers to fine-tune the ratio of machine stoppages caused by necessary quality control stops. Any manufacturer of demanding technical fabrics and composite...
textiles used in applications such as PCB manufacturing, automotive, architecture, filtration, aeronautics, medical and carbon industry can highly benefit from this type of versatile quality monitoring sensor. The implementation of FALCON-i optical yarn defect sensors in the quality control of any running yarn throughout the manufacturing process of fabrics is simple and easy.

FALCON-i’s unique flexibility to select the level of quality control enables technical fabrics manufacturers to respond quickly and flexibly to market trends, demand and developments.

Are you confronted with similar problems? Get in touch with us - Whatever your challenge, we're waiting, ready to accept it!

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In 2019, global shipments of spinning, texturing, weaving, knitting, and finishing machines decreased on average compared to 2018. Deliveries of new short-staple spindles, open-end rotors, and long-staple spindles dropped by -20%, -20%, and -66%, respectively. The number of shipped draw-texturing spindles declined by 4.5% and deliveries of shuttle-less looms shrunk by 0.5%. Shipments of large circular machines contracted by -1.2%, while shipped flat knitting machines fell by -40%. The sum of deliveries in the finishing segment also dropped by -2% on average.

These are the main results of the 42th annual International Textile Machinery Shipment Statistics (ITMSS) just released by the International Textile Manufacturers Federation (ITMF). The report covers six segments of textile machinery, namely spinning, draw-texturing, weaving, large circular knitting, flat knitting and finishing. A summary of the findings for each category is presented below. The 2019 survey has been compiled in cooperation with more than 200 textile machinery manufacturers representing a comprehensive measure of world production.

Spinning Machinery
The total number of shipped short-staple spindles decreased by about 1.7 million units in 2019 to a level of 6.96 million. Most of the new short-staple spindles (92%) were shipped to Asia & Oceania, where delivery decreased by -20%. While levels stayed relatively small, Africa and South America saw shipments increasing by +150% and +120%, respectively. The six largest investors in the short-staple segment were China, India, Uzbekistan, Vietnam, Pakistan, and Bangladesh.

563,600 open-end rotors were shipped worldwide in 2019. This represents a 147,500-units drop compared to 2018. 90% of global shipments went to Asia & Oceania where deliveries decreased by -21% to 517,000 rotors. Indonesia and Pakistan, the world's 5th and 6th largest investors in open-end rotors, increased their investments by +120% and 15%, respectively. China, Vietnam, India, and Uzbekistan, the world's 1st to 4th largest investors in 2019 decreased investment by -48% on average.

Global shipments of long-staple (wool) spindles decreased from 120,000 in 2018 to nearly 40,000 in 2019 (-66%). This effect was mainly driven by a fall in deliveries to Europe (-72%) and South America (-80%). 80% of total deliveries where shipped to China and India.

Texturing Machinery
Global shipments of single heater draw-texturing spindles (mainly used for polyamide filaments) increased by +12% from nearly 22,800 in 2018 to 25,500 in 2019. With a share of 88%, Asia & Oceania was the strongest destination for single heater draw-texturing spindles. China and Chinese Taipei were the main investors in this segment with a share of 64% and 12% of global deliveries, respectively.

In the category of double heater draw-texturing spindles (mainly used for polyester filaments) global shipments decreased by -5% to a level of 464,000 spindles. Asia's
share of worldwide shipments decreased to 90%. Thereby, China remained the largest investor accounting for 77% of global shipments.

Weaving Machinery
In 2019, worldwide shipments of shuttle-less looms decreased by -0.6% to 133'250 units. Thereby, shipments in the categories of "air-jet" and "rapier and projectile" fell by -7.7% to 30'200 and -22% to 25'000, respectively. The deliveries of water-jet looms increased by +12% to 78'000. The main destination for shuttle-less looms in 2019 was Asia & Oceania with 95% of all worldwide deliveries. 98%, 93%, 86% of all water-jet, air-jet, and rapier/projectile looms went to that region. The main investors were China and India in all three sub-categories. Deliveries of weaving machines to these two countries reached 89% of total deliveries. Bangladesh further played an important role in the rapier/projectile segment with 20% of global shipments.

Circular & Flat Knitting Machinery
Global shipments of large circular knitting machines fell by -1.2% to 26'400 units in 2019. The region Asia & Oceania was the world's leading investor in this category with 86% of worldwide shipments. With 61% of all deliveries (i.e. 13'143 units), China was the favoured destination. India and Vietnam ranked second and third with 2'670 and 2'210 units, respectively. In 2019, the segment of electronic flat knitting machines decreased by -40% to around 96'000 machines. Asia & Oceania was the main destination for these machines with a share of 92% of world shipments. China remained the world's largest investor with an 80%-share despite a -44%-decrease in investments from 122'550 units to 68'760 units.

Finishing Machinery
In the "fabrics continuous" segment, shipments of stenters and washing (stand-alone) grew by +34% and +0.6%. The growth in stenter deliveries is mainly explained by the addition of ITMF's estimate for the number of stenters. The total number of shipped stenters of 1'700 units thus represents an estimate of the total market for this category.

In the "fabrics discontinuous" segment, the number of jigger dyeing / beam dyeing shipped rose by +35% to 561 units. Deliveries in all other machine categories in both finishing sub-segments (i.e. continuous and discontinuous) decreased in 2019.
Mr. Arvind Sinha, Past National President (2014-15 & 2015-17) of The Textile Association (India) passed away on Wednesday, July 15th, 2020 at 1.20 p.m. with the victim of Corona Virus. It is extremely shocking, unbelievable terrifying sad news for entire textile fraternity.

Mr. Arvind Sinha is B.Text Tech from TIT,Bhiwani of 1976 batch and MMS from Bombay University have been involved with various industries in India and abroad for more than thirty five years. He was a very talented and dynamic personality, role model and was a true back bone of all TITOBIAN. He worked very hard to fulfil his dreams. He has been very actively involved with World Bank and IMF for last many years for various projects and received many Appreciations and Merit Certificates for his involvement in his studies and project work. He was a Specialist on Chinese matter and involved internationally with various Institutions for studies on China and Far East. He was also actively involved in promoting and implementing Food Safety Management System under USFDA guidelines.

His study on human rights in jails widely appreciated and was heading for a Doctorate consideration by leading UK Management Institute. He has presented more than 200 papers so far in various leading conferences all over the world and more than 16 subjects including Art History, Defense Forces, Critical Management, Disaster Management, effective Relief supplies etc.

Mr. Arvind Sinha has been an Art and Antique collector and three of his records are listed in Guinness Book of World Records. He has established twice Guinness World Record in decorated Lapel Pins category. Mr. Sinha was making attempt for Third Guinness World Record of 1 Lac pins. Also, he has world record holder for postal stamps, Gold Coins and paintings collections.

He had occupied many prestigious posts in textiles at various bodies worldwide. He was a knowledge tank of international textile and food markets as a great player. Mr. Sinha was a one of the best friends and guide and speaker for various conferences.

He was associated with World Bank on various projects as a prominent leader, Founder member of Textile Friends Group and also Textile Forum. He was also had occupied many prestigious posts in textiles at various bodies worldwide. He was a knowledge tank of international textile and food markets as a great player. Mr. Sinha was a one of the best friends and guide and speaker for various conferences. He was very talented, knowledgeable and International personality.

Under his dynamic leadership TAI organized first World Textile Conference (WTC), celebrated 75th Birth Anniversary of TAI, organized 3 days mega Global Textile Congress 2015 at Bangkok, Thailand, organized Second World Textile Conference (WTC2), organized India-South Asia Textile Summit and organized first Educational Global Innovators Researchers Conclave. He has been a great mentor and supporter during all the time.

Mr. Sinha was currently Chief Advisor and CEO for Business Advisors Group which is a leading sourcing company for Relief Supplies globally and also the content creator and provider for critical studies and management issues. Shri Sinhaji’s contribution to the TAI will be remembered for a very long time. TAI and Textile sector of India have lost very well-known and respected personality.

TAI pray to the Almighty for everlasting peaceful stay in heaven to the departed soul and give his family enough courage to sustain this irreparable loss.

Dear Arvindji... miss you a lot!!!
Introduction:
In our nature, we are cultivating and growing varieties of plants and trees. Some are producing fruits, food material for animals and human beings, wood, gummy substances, grass for animals, and so many uses. We know some plants are grown in India and abroad, which are useful for textile products. Textile useful plants are Banana, Acetate, Bamboo, Coir, Cotton, Flax, Hemp, Jute, Lyocell, Modal, Ramie, Rayon, Sisal, Soya Protein, etc. These plants are naturally cultivated and are very useful for producing textile fibre, yarn and fabric from it. For uses in Apparels, Home furnishing material, etc. We will see some of above plants for its usefulness in our day to day life in various areas for wearing cloths, fashion garments, value added products, home fashion material and also for Geo Textile Civil use.

Banana fibre Fabric
These fibres are obtained from Banana Pseudo Stem leaves, can be extracted by decorticator machine, retting and degumming of fibre. It is of major content of cellulose 82 %, and hemicelluloses. Lignin material. Fibre can be spun using open end spinning, ring spinning, bast fibre spinning. It is strong fibre and has lower strain at break, its appearance is quite shiny, low density, and strong moisture regain of 13 %, smaller elongation 6.54 %. Used as natural absorbent, light density woven fabric. It has good modulus of elasticity. Tensile strength and Stiffness which makes it is prominent fibre material.

Fabric used for making of Handicrafts, Quality Paper cards, coffee, Tea bags, Filter cloths, Cushion cover, Table cloths, Curtains, Table mats, Hats, Shoes, Carpets, Fashion Garments, Shirts etc. Fabric is 100 % Organic, Bio Degradable, Completely Vegan, and Eco friendly. Used as Absorbent in colored wastewater from dyes of textile industry. It contains Pathogens protein, possess Antimicrobial, and Antibacterial properties. Due to hollow fibre structure, thus have good insulation and absorbance properties. Thermal conductivity of fibre is quite low, thus used as good thermal insulations.

Acetate fibre fabric
Acetate is fibre from Plant Abaca. Cellulose acetate is chemical textile or semi synthetic, made from purified cellulose cotton linters/ wood pulp. Cellulose acetate fabric is luxurious appearance, crisp or soft hand. High comfort to wearer, resist wrinkling. Fabric is having excellent drape ability and softness, Shrink, Moth and mildew resistance. Better moisture absorbency than synthetic fibres. No pilling problem. It can be used as Substitute for Silk in less expensive garments, Product from it is Eco friendly material. Uses in Blouses, Wedding and Party attire, lining, Special occasion Apparel. Home fashion usefulness for Draperies, Upholstery, Curtains, Bed Spreads. Fabric require dry cleaning, ironed through damp cloth as it has low thermal stability.

Modal Fibre Fabric
It is type of Rayon, semi -synthetic cellulosic fabric. Made from beech tree pulp tree by chemical process. It is biodegradable in nature, thus eco friendly. High wet modulus rayon, alternative to Silk or Cotton. It is strong because of tight weave and long fibre, more absorbent than cotton. Wicking moisture away from the body and keeping you fully fresh and cool. Thus this fabric is great for summer wear, fabric is breathable, great for shorts, and it is best fabric for Eczema. Fabric is Durable, light weight, resistant to pilling. Resist shrinking. Uses- Underwear, Pajamas, and house hold items like bed sheets and towels, Popular for scarves and night wear. It is super soft, naturally soft drape well hold up children active lifestyle. Blending cotton with modal, helps garments keep their shape. Washed in washing machine and cold water. Modal is revolutionary in fashion industry, with its light weight, stretching and breathable nature. Eco conscious, durable option for clothing and house wares.

Soyabean Fibre Fabric
It is leguminous plant its plant provide high quality protein. Fibre from soyabean plant contains 18 amino acids, added antibacterial element, and offers a protec-
Soyabean fibre is made from Soyabean cake after oiling by new Bioengineering technology. Protein is distilled from cake and refined. Auxiliary agent and biological enzyme function the spherical protein changes and then protein spinning liquid is confected by adding high polymer like acrylonitrile or poly vinyl alcohol to add strength. Then liquid is cooked. 0.9 to 3 dtex fibre is produced by wet spinning. Are reach in protein 37-42%. Its breaking strength is greater than cotton, wool, silk and viscose.

It is dyed with acid and reactive dyes. Its fibre has antibacterial properties. Thus useful for innerwear, sleep wear sportswear, bed sheets, towels, blankets and infants clothes. Soyabean fabric is eco-friendly, used for baby clothing offers many benefits to Baby breathability, warmth and comfort are outstanding.

It has Anti UV properties, are superior to cotton, viscose, silk. Absorptive of UV radiation up-to 99.7 %. It promotes micro circulation of skin and enforcing the immunity.

Due to low abrasion resistance, useful in Automobile textiles. Woven fabric has anti-crease easy wash, and fast dry properties. Fabric shows luster of realsilk, drapability, is good, fine degree of weave. Woven fabric is suitable for high grade shell fabric of shirtsing. Knitting shell fabric has soft and smooth handle and texture is light and thin. Fabric gives cashmere like hand and touch, silk like luster, cotton like moisture conduction, and wool like warm retentiveness. It offers a protective function to skin. It helps people feel better and live longer with an enhanced quality of life.

Bamboo Fibre Fabric
Bamboo fibre is from Bast family of Hemp and Flax fibre. Bamboo fibres are made from its stem, broken down with chemicals and liquid is forced through the spinnerate to create fibre, yarn is prepared by worsted and ring spinning system. Yarn characteristics - it is soft and drapable, smooth and luxurious in touch, good Breathability. Cool and comfortable to wear. Antistatic, Anti-Bacterial, Anti-Microbial, and Anti-Fungal properties. Yarns are Strong and Durable, Abrasion resistance, It Protect from harmful UV rays, and more moisture absorption than cotton, Fabric is having Moisture wicking properties. Natural Deodorizer, Hypoallergenic. Elastic in nature. Thermal regulating.

Fabric uses: It is comfortable, very breathable, having ultra-softness of cashmere and the sheen of silk.


Home furnishing: Bath towels, Bedding Sheets, Pillow covers.

Bamboo can cut into thin strips and can be woven into hats and shoes by farmers and fisherman for protection from Sun. Bamboo can be blended with Tencel, Cotton, and other fibres. They are also suitable for hygienic products like sanitary material such as sanitary napkins, absorbing pads, masks, bandages, and surgical gowns. Benefits - being antibacterial keeps you odour free and feeling, smelling fresh. Highly sweat absorbent, pulls moisture from skin for evaporation, moisture wicking keeps you dry. Powerful insulating properties, keeps you cooler in summer and warmer in winter. Thus very useful to wearer for feeling comfort.

Hemp fibre fabric: It is Bast fibre like Jute, kenaf, Flax and Ramie. It is cellulosic fibre. Hemp fibre is obtained from Cannabis Sativa plant. It has deep roots system, helps to prevent soil erosion, removes toxins, provides a disease break and activate the soil to benefit future crops. Fibres are stronger and most durable among all other natural textile fibres. It has good fibre length absorbency, moisture regain 12%, stress easily. It has excellent resistance to heat thus ability to prevent bad effect of sun light, highly bright like linen fibre. Its bleaching is difficult, dyeing with Reactive, Vat and Sulphur dyes.

Uses: Hemp is Coarse fibre, thus useful for Cordage, Rope, Tarpaulin, Interior design and apparels like Tapestry, Hats, Shawls, Rugs and Carpets, Posters and Towel. It keeps warmer in winter and cooler in summer than cotton. It block UV rays from Sunlight. It is useful for Fashion design and texture of silk, soft elasticity. Can be blended with Cotton, Linen, and Silk. Fabric Hemp / Polyester 60:40, Hemp/Wool 50:50 etc.

It is better to do Plantation of Cannabis Sativa plant to get Hemp fibre, to make yarn and fabric from it, as it is having usefulness.
ABROAD

Intertextile Home Textile
Date: 24th to 26th August, 2020
Venue: Shanghai, China
Website: https://interertextile-shanghai-hometextiles-autumn.hk.messefrankfurt.com/shanghai/en.html

VTexShow - Virtual Textile Exhibition
Date: 21st to 26th September, 2020
Website: www.textileExcellence.com
Please Register as visitor

International Exhibition of Textile Industry
Date: 01st to 03rd October, 2020
Venue: Sousse, Tunisia
Website: www.intertextunisia.com

ITMA ASIA + CITME
Date: 12th to 16th June, 2021
Venue: National Exhibition and Convention Center, Shanghai, China
Website: http://www.itmaasia.com

ITM 2021
Date: 22nd to 26th June, 2021
Venue: Istanbul
Website: www.itmexhibition.com

FILTECH 2021
Date: 23rd to 25th August, 2021
Venue: Cologne, Germany
Website: https://filtech.de

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.

TAI developed Online Membership Registration Form

The Textile Association (India) developed an Online Membership Registration Form, which is uploaded on TAI website www.textileassociationindia.org/membership/

It is made simple to enroll Life Time / Patron Membership online.

Following process is to fill-up the form:
◆ Open TAI website, click on Membership on Main Menu Bar.
◆ Click on Application Forms, where there are two sub-menu titles (Manual Form and Online Form).
◆ Before filling the Online Form, Bank payment transaction is required for New Members.
◆ Also, Scan copy/file of your Photo and Aadhar Card should be kept ready for attaching to the form.
◆ Clicking on Online Form, A MEMBERSHIP Online Registration Form will appear.
◆ Entire form to be filled and ensure that all columns are filled. There are some Mandatory Fields. If any columns are not filled in, it will show an error.
◆ Once fully filled Form is SUBMIT ted, a reply will be seen as Your FORM is received successfully. Thanks.

Confirmation of membership is subject to the approval of the Scrutiny Committee.

In case, if you are unable to open the website, please write below link in Browser to fill-up the form. https://www.textileassociationindia.org/membership-online-form/

For any assistant, please contact TAI Central Office.
ESSENTIAL – The all-in-one mill management system

ESSENTIAL simplifies mill management, connects process stages and increases efficiency of the entire spinning mill. It provides fact based optimization proposals, key performance indicators and even predicts downtime risks. The Rieter Digital Spinning Suite leverages digital technology in order to strengthen the expertise of mill staff, eliminate inefficiencies and optimize costs.
Better blending from the beginning: **BO-P**

The new portal bale opener allows up to 50% more working width and 25 to 40% better blending. At the same time, the portal concept saves floor space: The **BO-P** can also be placed close to a wall because the bale lay-down area is freely accessible.