

## DURABILITY OF AHIMSA SILK SHIRTINGS

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*Ahimsa silk shirting materials were evaluated to know the influence of mechanical properties on its serviceability of the shirting material. The extent of dependency of functional properties on mechanical properties were examined by regression test. The influence of yarn count, cloth count, cloth thickness on tensile strength, elongation and abrasion resistance of shirting materials were found to be statistically significant and positively related. Further, there existed no relationship between cloth count on tensile strength and yarn count on elongation.*

**Key words:** Ahimsa silk, Abrasion resistance and pilling, Serviceability, Tensile strength.

### INTRODUCTION

Every fabric produced on handloom, powerloom or in mill sector need to perform the intended functions satisfactorily. In other words money spent on clothes is worth serves the purpose of maximum utility of the consumer. Of the several properties, durability or service-ability is prime feature that depends on the constructional details of the cloth. The functional properties viz., tensile strength, elongation, resistance to abrasion and pilling do significantly influence the fabric serviceability. However, these properties are derived from fibre

and yarn quality that ultimately constitute the fabric structure. Furthermore, the functional properties along with the inherent fibre characteristics contribute greatly to the fabric behaviour under deformation and comfort.

The present area of the study focuses on the influence of mechanical properties on the functional properties of Ahimsa silk shirtings. The spun silk from pierced cocoons without killing pupae considered as "Ahimsa silk" is widely accepted by Hindus and Jain royal families in India. Thus the silk spun from mulberry pierced cocoons is referred as "Ahimsa

silk". The coarser uneven Ahimsa silk yarn is most suitable for handloom sector and appropriately used as shot weft. It is a new venture in this sector, since Ahimsa silk is compatible to interweave with cotton, rayon, tericot and filature silk to produce designers shirtings.

On production of these varieties of union shirtings were assessed for functional properties to evaluate the influence of mechanical properties on the durability of the fabric. The extent of the dependency of functional properties on mechanical properties was further examined by regression test.

**Table - 1: Fabric Information of Newly Designed Shirting Materials**

| Sr. No. | Shirting Materials                              | Direction | Fibre Content | Colour Composition | Dye Composition | Yarn Type | Twist Direction | Yarn Count (Ne/d)             | Threads/ Inch | Cover Factor | Cloth Cover | Weave Type |
|---------|---|-----------|---------------|--------------------|-----------------|-----------|-----------------|-------------------------------|---------------|--------------|-------------|------------|
| 1.      | Cotton X<br>Ahimsa Silk<br>Shirting (Sc)        | Warp      | Cotton        | White              | -               | 2 ply     | Z               | 40 <sup>s</sup>               | 52            | 8.22         | 13.87       | Plain      |
|         |   | Weft      | Ahimsa Silk   | White              | -               | Single    | Z               | 36 <sup>s</sup>               | 48            | 8.00         |             |            |
| 2.      | Tericot x<br>Ahimsa Silk<br>Shirting (St)       | Warp      | Tericot       | White              | -               | Single    | S               | 60 <sup>s</sup>               | 54            | 6.97         | 12.64       | Plain      |
|         |   | Weft      | Ahimsa Silk   | White              | -               | Single    | Z               | 34 <sup>s</sup>               | 44            | 7.54         |             |            |
| 3.      | Filature Silk x<br>Ahimsa Silk<br>Shirting (Sf) | Warp      | Filature Silk | White              | -               | 2 ply     | S               | 241 <sup>s</sup><br>(20/22 d) | 120           | 7.72         | 17.02       | Plain      |
|         |   | Weft      | Ahimsa Silk   | White              | -               | Single    | Z               | 35 <sup>s</sup>               | 76            | 12.85        |             |            |

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## MATERIAL AND METHODS

The bivoltine and multivoltine cocoons were softened by boiling in a solution of soap + soda (3 and 1.5 gpl) and spun on CSTR motorized spinning machine developed by Central Silk Technological Research Institute, Bangalore. Ahimsa silk union shirtings were woven at different handloom weaving centers of Karnataka. Employing Ahimsa as weft, the shirting materials were woven in Cotton, Tericot and Filature silk as warp on the pitlooms. The detailed information on the fabric particulars is presented in Table - 1.

### Physical Testing of Samples

In the present study the shirting were tested for important mechanical properties of the fabric viz., yarn count, cloth count, cloth thickness and cloth stiffness and functional properties of cloth tensile strength, elongation, cloth abrasion and pilling.

### Test Methods

The union shirting materials were tested for mechanical and functional properties as per the standard methods (Table - 2).

## RESULTS AND DISCUSSION

### Assessment of Mechanical Properties of Newly Designed Ahimsa Silk Shirtings

Table - 3 reveals that, control sample and Cotton x Ahimsa Silk Shirting materials (Sc) were

interwoven with coarser warp and weft than the Filature silk (S<sub>F</sub>) and Tericot (S<sub>T</sub>) content shirting materials may be because of fibre content and staple length.

Further, among the shirting materials, Filature silk x Ahimsa silk (S<sub>F</sub>) was woven with greater number of ends and picks per unit area than the Tericot (S<sub>T</sub>) and Cotton (S<sub>C</sub>) shirting materials. This may be because of Filature silk yarns that are finer in count/denier, constructed with higher reed count to achieve better cloth balance, which in turn resulted into compact alignment of threads per unit area.

Same table reports on cloth thickness of test samples. Because of coarser yarn and irregular surface of Ahimsa silk (S<sub>C</sub>), control sample possessed maximum thickness than the newly woven

shirting materials. Among the newly designed shirting materials Cotton x Ahimsa silk (S<sub>C</sub>) was relatively thicker fabric may be due to coarser yarn count and presence of sizing materials on the surface than the Tericot (S<sub>T</sub>) and Filature silk (S<sub>T</sub>) content shirting materials.

### Assessment of Functional Properties of Newly Designed Ahimsa Silk Shirtings

#### *Cloth Tensile Strength (kgf) and Elongation (%)*

It was observed from the Table - 4 that, Tericot x Ahimsa silk (S<sub>T</sub>) shirting material possessed greater tensile strength may be because of yarn composition, i.e. Tericot yarn is a blend of Polyester x Cotton in proportion of 65:35. Polyester both in filament and staple form is strong to very strong because of its extremely crystalline polymer

Table - 2: Physical Testing of Ahimsa Silk Shirting Materials for Selected Properties

| Sl. No. | Properties                         | Instruments                          | Standard Methods |
|---------|------------------------------------|--------------------------------------|------------------|
| 1.      | Cloth Count (numerical Expression) | Pick Glass                           | –                |
| 2.      | Cloth Thickness (mm)               | Shirleys Thickness Tester            | ASTM-1777-1975   |
| 3.      | Cloth Tensile Strength (kgf)       | Hounsfeild Universal Testing Machine | IS:12676-1989    |
| 4.      | Cloth Abrasion Tester (Cycles)     | Martindals Abrasion Tester           | –                |
| 5.      | Cloth Pilling                      | Heals Pilling Tester                 | IS:10971-1874    |

Table - 3 : Mechanical Properties of Newly Designed Shirting Materials

| Shirtings                                     | Direction     |             | Yarn Count (Ne) |      | Cloth Count (Ne) |      | Cloth Thickness (mm) |
|---|---------------|-------------|-----------------|------|------------------|------|----------------------|
|   | Warp          | Weft        | Warp            | Weft | Warp             | Weft |                      |
| Control (Ahimsa Silk x Ahimsa Silk)           | Ahimsa silk   | Ahimsa silk | 35s             | 35s  | 24               | 20   | 0.50                 |
| Cotton x Ahimsa Silk (S <sub>C</sub> )        | Cotton        | Ahimsa silk | 40s             | 36s  | 52               | 48   | 0.46                 |
| Tericot x Ahimsa Silk (S <sub>T</sub> )       | Tericot       | Ahimsa Silk | 60s             | 34s  | 54               | 44   | 0.38                 |
| Filature Silk x Ahimsa Silk (S <sub>F</sub> ) | Filature Silk | Ahimsa Silk | 241s 20/22d     | 35s  | 120              | 76   | 0.29                 |

**Table - 4: Cloth Tensile Strength (kgf) and Elongation (%) of Newly Designed Shirting Materials**

| Shirtings                                     | Tensile Strength (kgf) |       | Elongation (%) |       |
|---|------------------------|-------|----------------|-------|
|   | Warp                   | Weft  | Warp           | Weft  |
| Control (Ahimsa Silk x Ahimsa Silk)           | 40.99                  | 46.48 | 14.87          | 13.81 |
| Cotton x Ahimsa Silk (Sc)                     | 41.71                  | 51.84 | 18.93          | 14.70 |
| Tericot x Ahimsa Silk (S <sub>T</sub> )       | 49.68                  | 66.90 | 26.94          | 12.41 |
| Filature Silk x Ahimsa Silk (S <sub>F</sub> ) | 32.86                  | 57.52 | 28.78          | 15.40 |

system, exhibiting very good tenacity. Further percentage of polyester content in Tericot blend being greater might have resulted into greater tenacity. In general the weft-way strength was higher than warp-way may be due to combined effect of fibre content and coarser yarn i.e. Ahimsa silk is considered to be stronger than Cotton, Tericot and Filature silk.

The perusal of Table 4 revealed about elongation of test samples, where in warp-way elongation (%) was found to be greater in Filature silk x Ahimsa silk shirting material may be because of cloth set i.e. higher the treads per unit area better the stretchability. In a fabric just off the loom, the warp threads generally have higher crimp because the filling yarns are shot straight through the shed and the

warp yarns are go over and under the filling yarns by the up and down motion of the harness. Hence the warp threads stretch relatively more compared to their weft. On the other hand weft-way elongation (%) was lesser among all the samples because these samples were woven with spun yarn of lower TPM (Turns Per Meter).

**Influence of yarn count and cloth count on cloth tensile strength of newly designed shirtings**

Table - 5 discloses on influence of yarn count and cloth count on cloth tensile strength of newly woven shirting materials. Yarn count significantly influenced the cloth tensile strength at 5 per cent level but the relation was negative i.e. increase in yarn count resulted into decrease in tensile strength, which

means finer the yarn lesser the strength. On the other hand, cloth count did not influence the cloth tensile strength. Further the influence of yarn count and cloth count on cloth tensile strength is explained by R<sup>2</sup> value i.e. 62 per cent and 54 per cent respectively.

**Influence of Yarn Count and Cloth Count on Cloth Elongation of Newly Designed Shirtings**

The influence of yarn count and cloth count on cloth elongation as presented in Table - 5 was found to be statistically significant i.e. there was relationship between independent and dependent variables of the test samples. However, cloth count and elongation are positively related and were significant at 5 per cent level in warp direction i.e. increase in cloth count resulted into increase in elongation percentage in warp-way, but in weft direction, the cloth count and elongation were negatively related and significant at 5 per cent level i.e. increase in cloth count resulted into decrease in elongation percentage. Further influence of yarn count and cloth count on elongation is explained by R<sup>2</sup> values i.e. 71 per cent and 42 per cent, respectively.

**Table - 5: Influence of Yarn Count and Cloth Count on Cloth Tensile Strength and Elongation of newly Shirting Materials**

|                  | Source         | Warp        |                |                      |         | Weft        |                |                      |         |
|------------------|----------------|-------------|----------------|----------------------|---------|-------------|----------------|----------------------|---------|
|                  |                | Coefficient | Standard Error | t Value              | P Value | Coefficient | Standard Error | t Value              | P Value |
| Testing Strength | X <sub>1</sub> | -1.1733     | 5.2901         | -2.218*              | 0.049   | -4.434      | 1.6783         | 2.648*               | 0.023   |
|                  | X <sub>2</sub> | 1.6248      | 1.2787         | 1.271 <sup>NS</sup>  | 0.230   | 2.3447      | 9.0042         | 2.60 <sup>NS</sup>   | 0.25    |
|                  | R <sup>2</sup> | 0.62        |                |                      |         | 0.54        |                |                      |         |
| Elongation       | X <sub>1</sub> | -6.5844     | 4.7160         | -1.396 <sup>NS</sup> | 0.190   | -1.7536     | 3.4852         | -0.503 <sup>NS</sup> | 0.625   |
|                  | X <sub>2</sub> | 2.9290      | 1.1399         | 2.570*               | 0.026   | -4.2686     | 1.8699         | -2.283*              | 0.043   |
|                  | R <sup>2</sup> | 0.71        |                |                      |         | 0.42        |                |                      |         |

\*\* - Significant at 1 per cent level  
 \* - Significant at 5 per cent level  
 NS - Non-Significant

X<sub>1</sub> = Yarn Count  
 X<sub>2</sub> = Cloth Thickness

*Cloth Abrasion Resistance (Cycles)*

Table - 6 illustrates about cloth abrasion resistance of test samples. The relatively coarser, thicker and loosely woven control sample showed better resistance to abrasion compared to newly woven shirting materials. However, newly woven shirting materials exhibited low resistance to abrasion attributed to its yarn count, low thickness value and pliable texture.

On abrasion loss in cloth thickness was found to be remarkable in control sample may be influenced by frictional abrasion that lead to fibre breakage. Consequently there was also loss in mass. During the process of abrasion the fibrous substance in the form of dust is raised from the fabric surface and gradually resulted into fuzz, nap and finally the yarn breaks. Due to this action, test samples showed decrease in cloth thickness and loss in mass per unit area. Similar results were observed on the study conducted by Joshua (1993) and Nemailal and Probir (1999) revealed that the continuous surface abrasion result into decrease in fabric weight and thickness.

**Table - 6 : Cloth Abrasion Resistance of Newly Designed Shirting Materials (Cycles)**

| Shirting Material                   | Number of Cycles | Loss in Mass (%) | Loss in Thickness (%) |
|-------------------------------------|------------------|------------------|-----------------------|
| Control (Ahimsa Silk x Ahimsa Silk) | 272.00           | 5.00             | 8.00                  |
| Cotton x Ahimsa Silk (Sc)           | 30.00            | 3.03             | 5.26                  |
| Tericot x Ahimsa Silk (Sr)          | 26.00            | 1.36             | 6.52                  |
| Filature Silk x Ahimsa Silk (Sf)    | 23.00            | 3.13             | 6.89                  |

**Influence of Yarn Count and Cloth Thickness on Loss in Thickness of Newly Designed Shirtings on Abrasion**

It is apparent from Table - 7 that yarn count and cloth thickness on loss in thickness are positively related and highly significant in warp direction i.e. increase in yarn count and cloth count resulted into greater loss in cloth thickness. On the other hand the relationship between weft-way yarn count and cloth count on loss in thickness were statistically non-significant.

Further, influence of yarn count and cloth count on abrasion is explained by R<sup>2</sup> values, i.e. 79 per cent and 17 per cent, respectively.

Table 7 discloses the influence of yarn count and cloth thickness on loss in mass on abrasion. There existed no relationship between

independent and dependent variables of the test samples since the values were statistically non-significant. Further it was explained by R<sup>2</sup> value i.e. 5 per cent and 23 per cent respectively.

*Cloth Pilling (Ratings)*

A perusal of Table - 8 showed pilling appearance of test samples. Pilling is the fabric fault characterized by little pills of entangled fibre clinging to the cloth surface that gives the garment an unsightly appearance. The pills are formed during wear and washing by the entanglement of loose fibres which protrude from the fabric surface.

From this table it is clear that all the test samples showed slight to moderate pilling owing to their fibre content and yarn type. These findings are on par with the results of Praveena and Vatsala (1992).

**Table - 7 : Influence of Yarn Count and Cloth Thickness on Abrasion Resistance of Newly Designed Shirting Materials**

|                   | Source         | Warp        |                |                     |         | Weft        |                |                      |         |
|-------------------|----------------|-------------|----------------|---------------------|---------|-------------|----------------|----------------------|---------|
|                   |                | Coefficient | Standard Error | t Value             | P Value | Coefficient | Standard Error | t Value              | P Value |
| Loss in Mass      | X <sub>1</sub> | 1.6870      | 3.1544         | 5.320**             | 0.000   | -1.0234     | 3.1414         | -0.326 <sup>NS</sup> | 0.751   |
|                   | X <sub>2</sub> | 1.9694      | 3.3256         | 5.922**             | 0.000   | 4.2695      | 4.1469         | 1.030 <sup>NS</sup>  | 0.325   |
|                   | R <sup>2</sup> | 0.79        |                |                     |         | 0.17        |                |                      |         |
| Loss in Thickness | X <sub>1</sub> | 3.2661      | 8.9856         | 0.363 <sup>NS</sup> | 0.723   | 6.0413      | 3.9726         | 1.521 <sup>NS</sup>  | 0.157   |
|                   | X <sub>2</sub> | 6.0923      | 9.4735         | 0.643 <sup>NS</sup> | 0.533   | 6.8698      | 5.2442         | 1.310 <sup>NS</sup>  | 0.217   |
|                   | R <sup>2</sup> | 0.05        |                |                     |         | 0.23        |                |                      |         |

\*\* = Significant at 1 per cent level  
 \* = Significant at 5 per cent level  
 NS = Non-Significant

X<sub>1</sub> = Yarn Count  
 X<sub>2</sub> = Cloth Thickness  
 R<sup>2</sup> = Coefficient of Determination

**Table - 8: Cloth Pilling of Newly Designed Shirting Materials (Ratings)**

| Shirting Material                             | Pilling (Rating) |
|---|------------------|
| Control (Ahimsa Silk x Ahimsa Silk)           | 3                |
| Cotton x Ahimsa Silk (Sc)                     | 3                |
| Tericot x Ahimsa Silk (S <sub>T</sub> )       | 3                |
| Filature Silk x Ahimsa Silk (S <sub>F</sub> ) | 2                |

- 1 - No pilling  
 2 - Slight but tolerable pilling  
 3 - Moderate pilling of border line accept

- 4 - Severe pilling  
 5 - Extremely high pilling

## CONCLUSION

Among the test samples, Tericot x Ahimsa Silk (S<sub>T</sub>) Shirting material exhibited relatively greater tensile strength in both directions. Yarn count and tensile strength of newly designed shirting materials were found to be negatively related. Filature silk x Ahimsa (S<sub>F</sub>) shirting showed highest elongation in warp way followed by Tericot (S<sub>T</sub>) and Cotton (Sc) shirtings. Cloth count positively influenced the warp way elongation of newly designed shirtings, but the relationship was

negative in weft-way. Among the shirting materials Cotton x Ahimsa Silk (Sc) possessed greater warp tear strength followed by Tericot (S<sub>T</sub>) and Filature silk (S<sub>F</sub>) shirtings. Cotton x Ahimsa silk (Sc) shirting exhibited higher resistance to abrasion than the rest of the samples. The influence of warp way yarn count and cloth thickness on loss in thickness of shirting materials were found to be statistically significant and were positively related. But, loss in thickness of test samples was

independent of their corresponding weft-way yarn count and cloth thickness.

Ahimsa Silk cannot be machine spun hence making it most suitable for handloom sector. Present situation of the handloom industry is very excruciating and that of the handloom weavers pathetic. Therefore, the handspun ahimsa yarn would be suitable as weft for production of made-ups having demand even in the international markets. Designing such traditional goods would further help the handloom sector in creating job work for the weavers and in turn help to uplift their standard of living.

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