International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

# Assessment of Physical Properties of Cotton with Ahimsa and Conventional Silk Union Fabrics

**Neelam Sharma[1], Dr. Minakshi Jain[2], Dr. Radha Kashyap[3]**

[1]Research Scholar, Fashion and Textile Department, The IIS University Jaipur

[2]Associate Professor, Govt. Girls College, Chomu (Jaipur)

[3]Professor, Fashion and Textile Department, The IIS University, Jaipur

**Abstract:** ***Silk fiber is the most beautiful natural fiber known as the "Queen of Textiles". Ahimsa silk is an eco-friendly, sustainable and non-violent process of the production. Cotton is a versatile fabric full of comfort properties. Hand spun and hand woven cotton fabric is another model of sustainable fabrics. Therefore, union fabrics in different ratios were prepared from Khadi cotton and ahimsa silk yarns (Eri Silk) and conventional Silk yarns (Muga Silk and tussar silk). Assessment of physical properties of Khadi cotton with Ahimsa silk and Conventional Silk union fabrics has been accomplished in this research. Objective of the study was to prepare union fabrics in three different ratios Eri*Cotton 33:67, Eri*Cotton 50:50 and Eri*Cotton 67:33 and assessment of its physical properties. These fabrics were tested in the wool Research Association for their crease resistance (resilience), pilling, shrinkage, tearing strength; moisture regain (absorbency) and drapability etc. The results indicate that Khadi cotton-ahimsa silk union fabrics are compatible to the other Khadi cotton- conventional silk union fabrics in their physical and comfort properties, so can be used for various garment construction.***

**Keywords:** Ahimsa silk, conventional silk, Khadi cotton, physical properties, union fabrics

## 1. Introduction

Silk, one of the oldest fibers known to man, originated in China. Empress Hsi Ling Shi, wife of Emperor Huang Ti (also called the Yellow Emperor), was the first person to accidentally discover silk as wearable fiber. When the empress was sipping tea under a mulberry tree, one day. A cocoon fell into her cup and began to unravel. The empress became so enamored with the shimmering threads, she discovered their source, the *Bombyxmori* silkworm found in the white mulberry. The empress soon developed sericulture, the cultivation of silkworms, and invented the reel and loom. Thus began the history of silk (http://kehwahsilk.com). Silk is a very special natural fiber. It is lustrous and smooth, drapes well and is very strong. Silk takes dyes very well and can be made in brilliant colors.

*Ahimsa Silk* is Peace Silk, Ahimsa silk processed from cocoons without killing the pupae inside. "Ahimsa" meaning "nonviolence" process of Ahimsa silk is produced without killing of silkworms. **(http://www.seidentraum.eu).**

Silk is a part of Buddhist philosophy, stating that humans should refrain from inflicting suffering on others, including non-human and even non-animal life. There are some other religious groups with many similarities to Buddhists, who take this philosophy so deeply to heart that they avoid killing even the smallest creatures, and provide special houses where insects swept up in household dirt can live out their lives (http://www.wormspit.com/peacesilk.htm). Ahimsa silk is not only environmentally friendly, vegan and ethical, it's also extremely luxurious in terms of the drape and texture of the fabric.

Khadi is a hand spun and hand woven fabrics. This process is a labor oriented. The process is believed to be 5000 years old having its roots ancient India. This process almost forgotten was revived by Mahatma Gandhi in 1921 against the British. Hand spun cotton yarn enhancing wear comfort ability and durability of fabric (https://www.chemarc.com).

The Ahimsa and conventional silk union fabrics obtained will offer flexibility in choosing varieties of fabric with cost effective yet attractive fabric. Therefore, the combination of the cotton with Ahimsa silk and Conventional silk will reduce the cost of fabric as well as weight to the fabric. The combination will improve the physical properties of the fabrics.

## 2. Review of Literature

Influence of blend ratio in the properties of bamboo and silk woven fabrics was studied by Saikia, Kalita and Kaur (2015**).** To blend bamboo fiber with silk, fabric of plain weave was constructed using blended yarns. The bamboo and silk fibers were blended in carding and drawing stage and yarn produced in three different ratios 20:80, 50:50 and 80: 20 were studied. In this method, the yarns produced were then wound to form cones. The controlled and blended fabrics were weaved in the fabric Plus Industry Private Ltd. Guwahati, Assam. From the different blended yarn, fabric constructed using plain weave. The result found that test samples highest tensile strength (62 kg f) was shown by Bamboo x mulberry silk plain (BMP) weave (50:50) in warp direction. While in weft direction sample BMP (80:20) was maximum strength (55.67 kg f) and lowest strength was found warp and weft way in Bamboo plain weave. The elongation in warp direction in warp direction sample BMP (50:50) shows highest (20.12%) while in weft direction. Sample BMP 80:20 shows maximum elongation 25.67% while sample BP was least. Drape coefficient was found in controlled fabric sample mulberry plain weave and lowest drape coefficient was found in fabric sample 80:20. Bamboo mulberry 80:20 blended test fabrics attained the highest

absorbency while mulberry plain control sample recorded lowest absorption of water. The 80:20 blend proportions shows better result than other blends, which is required for clothing materials.

Gamal (2014) correlated garment appearance and fabric drape from FAST mechanical properties. The garment appearance value was visually assessed. Twenty four fabrics were chosen in this study. These were cotton, polyester, and cotton-polyester fabrics with different weights (light, Medium, Heavy) and different structures. Eight designs were created for each group. A three level questionnaire was used for selecting the optimum design. FAST System was used to measure fabric low stress mechanical properties. Results found that the garment. Appearance is affected by combinations of fabric properties. The relationship between garment appearance, fabric mechanical properties, and fabric drape was not Linear. Drape coefficient was lower and the garment appearance was higher. Fabric drape is important in garment appearance. The more draped fabrics give higher garment appearance.

Performance of jute viscose/ polyester and cotton blended yarns for apparel use was evaluated by Bhardwaj and Juneja (2012). Blended yarn were prepared with jute 50% viscose 50% polyester 100% used in three different ratio jute/ viscose and polyester used 70/30, 50/50, 30/70. Jute viscose / polyester yarns were used in weft direction and cotton yarn was used in warp direction. Results depicted that jute viscose and polyester (30/70) has maximum weight as compared to jute viscose/polyester (50/50) and jute viscose and polyester (70/30). Crease recovery angle shown by jute viscose and polyester (70/30) was better as compared to jute viscose and polyester (50/50) and jute viscose and polyester (30/70). Thickness of jute viscose and polyester (30/70) union fabric was highest than other two blends. Maximum absorbency was found by viscose/ polyester (30/70) and minimum was jute/ polyester (70/30). Drapability was 70/ 30 polyester/ viscose fabric greater as compared to other union fabrics. Union fabric with a ratio of (30/70) jute viscose and polyester was found better than other blended fabrics.

Kulkarni, Mahale and Kariyappa (2011) developed viscose rayon and Eri silk union fabrics. The possibilities of weaving viscose rayon and Eri silk union fabrics and assessment of mechanical and functional properties of union fabrics were studied by them. Viscose rayon of 75d as warp and Eri silk of three different yarn counts viz. 2/40s, 2/60s and 2/80s as weft were woven on a semi- automatic power loom at Doddballapura of Bangalore District. A total of four different sets of fabrics were produced viz. viscose rayon x viscose rayon (control), viscose rayon x Eri silk 2/40s, viscose rayon x Eri silk 2/60s and viscose rayon x Eri silk of 2/80s. The results revealed that viscose rayon x Eri silk of 2/40s exhibited maximum thickness which may be due to coarser yarn count and irregular yarn surface and greater tensile strength in warp and weft direction may be because of yarn composition of Eri silk, a spun silk with coarser yarn count. The resistance to abrasion and highest value of drape coefficient of viscose rayon x Eri silk of 2/40s showed better to other test samples. Overall performance of viscose rayon x Eri silk of 2/40s union fabric gave better results when compared to other test samples.

The effect of loop length on the dimensional properties of silk and model union knitted fabric was evaluated by Prakash and Koushik (2010). In this study, single jersey plain knitted fabric samples with three different loop lengths were produced. Results proved that the courses per inch increased with an increase in loop length; Course per inch increased after fabric wet- relaxation. Wales per inch decrease with an increase in loop length; Wales per inch decrease after wet- relaxation. Loop length increase after wet relaxation process. Increase in the thickness of fabric was observed with an increase in loop length. The dimension of fabric showed considerable change during wet relaxation.

Ahimsa silk shirting materials were evaluated to know the influence of mechanical properties on the serviceability of the shirting material. Objective of the study were to assess functional properties and to evaluate the influence of mechanical properties on the durability of the Ahimsa silk fabric (Sanapapamma and Shailaja, 2007). The union shirting materials were tested for mechanical and functional properties as per the standard method in Karnataka. Result showed that cotton x Ahimsa silk (Sc) was relatively thicker fabric, which might be due to coarser yarn count and presence of sizing materials on the surface than the tricot and filature silk content shirting material. Ahimsa silk was considered to be stronger than cotton, tricot and filature silk. Filature silk x Ahimsa silk shirting higher the treads per unit area better the stretch ability. Yarn count significantly influenced the cloth tensile strength but the relation was negative, i.e. increase in yarn count turned into decrease in tensile strength. Cloth count positively influenced the warp way elongation of newly designed shirting, but the relationship was negative in weft way. Newly woven shirting materials exhibited low resistance to abrasion attributed to its yarn count, low thickness value and pliable texture.

After review of available literature, it has become clear that only few studies have been conducted on the assessment of mechanical and functional properties of different types of union fabrics made of ahimsa silk, rayon, cotton and synthetic yarns fabric in different ratios but no previous study was found concerning assessment and comparison of physical and comfort properties of ahimsa and conventional silk with cotton union fabrics.

**Objectives of the Study**

- To prepare union fabric of Ahimsa silk and conventional silk yarns with hand spun cotton yarns in different ratios.
- Assessment and comparison of physical and comfort properties of the prepared union fabrics.

## 3. Material and Method

The study was undertaken to evaluate union fabric of Ahimsa and Conventional silk yarns with Cotton hand spun yarns in three different ratios viz. 33:67, 50:50, and 67:33 respectively. The Ahimsa silk and Conventional silk yarns were collected from M/s S. B. Corporation, Raipur Chhattisgarh. After collecting the yarn, different union

fabrics were developed in three ratios (33:67, 50:50 and 67:33). The silk–Khadi cotton union fabrics were woven at weaver's services centre, Jaipur. After the weaving of union fabrics, the fabric samples were tested to determine their physical properties. Nine different plain woven fabric samples was produced using Ahimsa silk, conventional silk and hand spun cotton yarns, and then the physical and comfort properties of Ahimsa and Conventional silk union fabric were assessed and compared. Physical properties were assessed with the following methods: Crease recovery (method IS 4681), Pilling resistance (method ISO 12945-2), Tear strength (method ASTM D 1424), Dimensional stability (method ISO 6330):4N (4 degree C), (After One wash and Dry Cycle), Moisture regains (method (TL/SOP/03) and Drape coefficient (method ISO 9073-9).

## 4. Results and Discussion

The union fabrics samples prepared by Ahimsa and Conventional silk yarns with Cotton hand spun yarns in three different ratios viz. 33:67, 50:50, and 67:33, for the purpose of study, have been shown in table 1.

**Table 1:** Union Fabrics

| Samples and Ratios | 33:67 | 50:50 | 67:33 |
|---|---|---|---|
| Muga*Cotton |  |  |  |
| Tussar*Cotton |  |  |  |
| Eri*Cotton |  |  |  |

**Assessment of physical and comfort properties of the prepared union fabrics:**

**Table 2:** Assessment of Moisture Regain

| Union Fabrics | Muga*Cotton | | | Tussar*Cotton | | | Eri*Cotton | | |
|---|---|---|---|---|---|---|---|---|---|
| Ratios | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 |
| Moisture Regain | 9.69 | 9.21 | 8.80 | 9.43 | 9.14 | 8.72 | 9.78 | 9.33 | 8.94 |

Moisture regain influences absorption capacity of the fabric and influences the comfort features of the end products. Table 2 presents the moisture regain of produced union fabrics. It can be observed from the table that fabric moisture regain of Eri*Cotton (33:67) was highest 9.78, for Muga*cotton (33:67) it was 9.69 and Tussar*Cotton (67:33) fabric shown the lowest moisture Regain 8.72. The Statistical results indicate that moisture regain of all the test samples are compatible and there is no significant difference between different union fabrics produced.

**Table 3:** Crease Recovery

| Union Fabrics | | Muga*Cotton | | | Tussar*Cotton | | | Eri*Cotton | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Ratios | | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 |
| Properties | Crease Recovery | 178.7 | 193.7 | 187.0 | 199.2 | 183.2 | 182.0 | 186.6 | 183.7 | 211.5 |

Crease recovery is a property related to care and ease of maintenance of the garment. The above table depicted crease recovery angle of all the prepared union fabrics. Greater crease recovery indicates lesser maintenance during use. Union fabric Eri*Cotton (67:33) was found to have maximum crease recovery 211.5 followed by Tussar*Cotton (33:67) with a value of 199.2 and lowest crease recovery value of 178.7 was shown by Muga*Cotton (33:67) fabric. The statistical results established that Eri*Cotton had higher crease recovery as compare to Conventional silk (Muga*Cotton, Tussar*Cotton) union fabrics because of yarn flexibility.

**Table 4:** Pilling Resistance

| Union Fabrics | | Muga*Cotton | | | Tussar*Cotton | | | Eri*Cotton | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ratios** | | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 |
| **Properties** | Pilling 125 Rubs | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 |
| | Pilling 1000 Rubs | 4 | 4 | 4 | 4-5 | 4-5 | 4-5 | 4 | 4 | 4 |
| | Pilling 5000 Rubs | 4-5 | 4-5 | 4-5 | 4 | 4 | 4 | 3-5 | 3-5 | 3-5 |

The pilling property is a very important in the performance as well as cleanliness and utilizable life of textile products. The pilling resistance of all constructed fabrics is reflected in table 4. It can be observed that among all the test samples

show high pilling – value for 125 rubs for all the three ratios of Muga*Cotton, Tussar*Cotton and Eri*Cotton was 4-5. Tussar*Cotton in three ratios showed highest pilling in 1000 rubs (value 4-5) and Eri*Cotton showed a lowest value of 3-5 for 5000 rubs. These results indicate that the pilling resistances of all the union fabrics are higher so all union fabric are compatible to each other.

**Table 5:** Drape Coefficient

| Union Fabrics | | Muga*Cotton | | | Tussar*Cotton | | | Eri*Cotton | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Ratios | | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 |
| **Properties** | Drape Coefficient Front | 62.4 | 57.4 | 56.6 | 59.2 | 60.6 | 67.4 | 56.86 | 54.1 | 64.1 |
| | Drape Coefficient Back | 64.9 | 58.1 | 51.3 | 64.1 | 65.4 | 63.7 | 50.99 | 54.4 | 55.1 |

Drape coefficient influences overall effect, design impact and fall of the dress. The highest drape coefficient for front face of the Tussar*Cotton (67:33) fabric was 67.4, for Eri*Cotton (67:33) it was of 64.1 value and lowest drape coefficient was 54.1 for front side of Eri*Cotton (50:50) fabric. Similarly, in the back side of fabric highest drape coefficient of 65.4 was depicted by Tussar*Cotton (50:50) and Muga*Cotton (33:67), i.e. 64.9 and the lowest value searched out was 51.3 for Muga*Cotton (33:67). The statistical results show the drape coefficient of Ahimsa silk and Conventional silk union fabric are compatible to use to fashion products not higher difference in all fabrics.

**Table 6:** Tear Strength

| Union Fabrics | | Muga*Cotton | | | Tussar*Cotton | | | Eri*Cotton | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ratios** | | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 |
| **Properties** | Tear Strength Warp | 4263.5 | 4428.6 | 5882.7 | 4230.6 | 4613.7 | 5003.7 | 4821.5 | 4541.1 | 4804.7 |
| | Tear Strength Weft | 4209.5 | 4538.5 | 5362.6 | 4289.9 | 4867.6 | 5164.0 | 4525.6 | 4173.1 | 4173.1 |

The tear strength is related to durability and serviceability of the fabric. The results of tear strength tests of the union fabrics examined are depicted in table 6. It can be observed in the table that in warp direction Muga*Cotton (67:33) fabric has shown maximum tear strength of 5882.7 followed by Eri*Cotton (33:67) with a value of 4821.5. In warp direction, the lowest tear strength of 4230.6 was found for Tussar*Cotton (33:67) fabric. Similarly, in the weft direction, the highest tear strength of 5362.6 and Tussar*Cotton (67:33) was 5164.0 and the lowest value 4173.1 was revels by Eri*Cotton (50:50 and 67:33). The statistical observed Muga*Cotton (67:33), Tussar*Cotton (50:50 and 67:33) and Eri*Cotton (33:67 and 67:33) good in tear strength. Eri*Cotton, Tussar*Cotton and Muga*Cotton (67:33) was compatible to other prepared union fabrics ratio.

**Table 7:** Dimensional Stability

| Union Fabrics | | Muga*Cotton | | | Tussar*Cotton | | | Eri*Cotton | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ratios** | | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 | 33:67 | 50:50 | 67:33 |
| **Properties** | Dimensional Stability Warp Direction | -8.56 | -7.42 | -6.56 | -10.9 | -9.78 | -9.3 | -10.5 | -10.6 | -9.4 |
| | Dimensional Stability Weft Direction | -12.39 | -10.9 | -8.72 | -14.1 | -13.21 | -11.39 | -12.6 | -14.0 | -11.9 |

Table 7 indicates that in warp direction of union fabric the highest dimensional stability (-10.9) was shown by Tussar*Cotton (33:67), followed by Eri*Cotton (50:50) with a value of -10.6 was of warp direction and Muga*Cotton (67:33) shows lowest -6.56 dimensional stability in warp direction. Similarly, dimensional stability -14.1 in weft direction of fabric Tussar*Cotton (33:67), Eri*Cotton (50:50) shows 14.0 value of dimensional stability in weft direction and lowest dimensional stability was – 8.72 shows by Muga*Cotton (67:33) in weft direction of fabric. Statistical results reveals that the dimensional stability of the union fabrics Eri*Cotton and Tussar*Cotton in warp and weft direction were higher as compare to Muga*Cotton.

## 5. Conclusion

From this study it can be concluded that in Eri*Cotton (67:33) shows highest crease recovery. Tussar*Cotton and Muga*Cotton and Eri*cotton union fabrics are compatible in physical and comfort properties (drape coefficient, pilling resistance, tear strength, dimensional stability). Ahimsa silk - cotton union fabrics is produced by eco-friendly method and is stronger, soft to wear and durable and is good in all season.Therefore, Ahimsa silk - cotton union fabrics are as suitable for making apparel products as the union fabrics made of conventional silk - cotton. The development of union fabric can be a milestone in creation of variety in fabric types in future, especially sustainable and ethical fabric for apparel production and to the fashion world. In a wider perspective, it will assist in preservation of our ecosystem and healthy environment of planet for generations.Along with this, these union fabrics are pocket friendly, so these can be serve middle income groups of the society in a better and economic way.

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