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# Physical properties of developed viscose rayon and eri silk union fabrics *

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**Abstract:** In the present study an attempt was made to develop union fabrics using viscose rayon as warp with esri silk of three different yarn counts *viz.*, 2/40s, 2/60s and 2/80s as weft on a semi automatic power loom. Further, the newly designed union fabrics were evaluated for physical properties and comparisons were made on the performance between different sets of union fabrics. Viscose rayon x eri silk of 2/40s (VRE1) showed highest tensile strength both in warp and weft directions. The control sample, Viscose Rayon x Viscose Rayon (VR) showed highest elongation percentage. Viscose rayon x eri silk of 2/40s (VRE1) union fabric exhibited highest resistance to abrasion. Overall the results indicated that Viscose rayon x eri silk of 2/40s exhibited better performance than other sets of fabric.

**Keywords:** Eri silk, mechanical and functional properties, rayon, union fabrics, viscose

## Introduction

The textile industry in India contributes to over 6 per cent of the Gross Domestic Production (GDP) of India and earns 18 per cent of the total foreign exchange earnings of the country. Being consumers every one has aspiration for asthetic and quality fabrics for ever. Among various fibres known, viscose rayon, the regenerated cellulosic fibre is unique in itself with equal sheen as that of silk. Viscose cotton and lycra. It has brilliant luster and high moisture regain capacity. These fibres have unique quality that makes it most suitable for fashionable yet comfortable rayon is stronger than wool with good heat conductivity and absorbency. This artificial silk is blend friendly and can be blended with polyester, nylon, silk and acrylic fabrics.

Looking into aesthetics of the textiles fibres, the first name that strikes our mind is silk. Silk, the glorious gift of nature is an intimae natural fibre which is also popular with splendor, sibilant with luster and spectacular in vision. India is the only country in the world which produces all the four varieties of silk namely Mulberry, eri, tussar and muga. The non-mulberry silks *viz.,* Tussar, eri and muga are collectively called as Vanya silks. Among these, eri silk also known as ahimsa silk accounts to 78.4 per cent and its contribution to the total raw silk production in the country is 7.26 per cent next to mulberry silk. Eri silk is mainly cultivated in north eastern region of India contributes nearly 98 per cent of in the country. Now, there is a vast scopes for development of ericulture all over India.

Eri silk cocoons are open mouthed therefore is spun like cotton. Eri silk is durable and strong with a typical texture. Eri silk appearance is like wood mixed with cotton and softness of silk. The staple length of the fibre is about 57 mm. The denier of the filament is 2.2 to 2.5 d with tenacity of 3 to 3.5 g/d. It has excellent thermal properties, which can be a substitute for wool. Eri silk is highly crystalline than any other non-mulberry silks (Sreenivasa *et al,* 2005). It has tremendous blending possibilities with other fibres like wool, cotton and polyester.

The survival of textile industry depends primarily on the iversification of end products to meet the national as well as international demands. Diversification in the product can be brought about at various stages *viz.,* yarn, fabric, design, fashion and style. Blends or union fabrics can be created with variegated novelty effect that caters to the fashion world today. Thus the present study highlights to explore the possibilities of weaving Viscose rayon and Eri silk union fabrics and to assess mechanical and functional properties of the newly designed union fabrics.

## Material and methods

Viscose rayon yarn and eri silk hanks were collected from Central Silk Technological Research Institute (2008), Central Silk Board, Bangalore.

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

Table 1. Constructional details of newly designed Viscose rayon and Eri silk union fabrics

| Union fabrics | Direction | Fiber content | Yarn type | Twist direction | Yarn count | Threads per inch | Cover factor | Cloth cover | Weave type |
|---|---|---|---|---|---|---|---|---|---|
| Viscose rayon x Viscose | Warp | Viscose rayon | Single | Z | 75d | 101 | 12.65 | 17.12 | Plain |
| rayon (control, (VR) | Weft | Viscose rayon | Single | Z | 75d | 83 | 9.98 | | |
| Viscosesrayon x Eri silk | Warp | Viscose rayon | Single | Z | 75d | 101 | 12.78 | 21.25 | Plain |
| of 2/40$^S$ (VRE$_1$) | Weft | Eri silk | 2 ply | S | 2/40$^S$ | 51 | 15.60 | | |
| Viscose rayon x Eri silk | Warp | Viscose rayon | Single | Z | 75d | 101 | 12.28 | 19.96 | Plain |
| of 2/60$^S$ (VRE$_2$) | Weft | Eri silk | 2 ply | S | 2/60$^S$ | 58 | 13.99 | | |
| Viscose rayon x Eri silk | Warp | Viscose rayon | Single | Z | 75d | 101 | 12.18 | 20.09 | Plain |
| of 2/80$^S$ (VRE$_3$) | Weft | Eri silk | 2 ply | S | 2/80$^S$ | 72 | 13.80 | | |

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Table 2. Loom particulars of viscose rayon and eri silk union fabrics

| Particulars | Union fabrics | | | |
|---|---|---|---|---|
| | VR (control) | $VRE_1$ | $VRE_2$ | $VRE_3$ |
| Type of loom | Semi automatic power loom | Semi automatic power loom | Semi automatic power loom | Semi automatic power loom |
| Reed count | 100 | 100 | 100 | 100 |
| Reed width | 52" | 52" | 52" | 52" |
| Cloth width | 44" | 44" | 44" | 44" |
| Denting order | 2 threads/ dent | 2 threads/ dent | 2 threads/ dent | 2 threads/ dent |

Note:
VR - Viscose rayon x Viscose rayon (control)
$VRE_1$ - Viscose rayon x Eri silk (2/40s)
$VRE_2$ - Viscose rayon x Eri silk (2/60s)
$VRE_3$ - Viscose rayon x Eri silk (2/80s)

*viz.,* viscose rayon x viscose rayon (control), viscose rayon x Eri silk of 2/40s, viscose rayon x eri silk of 2/60s and viscose rayon x eri silk of 2/80s where, comparative assessment was made between the union fabrics for their physical properties. The detailed information on loom and fabric particulars are presented in Table 1 and 2.

In the present study the union fabrics were tested for important mechanical properties of the fabric *viz.,* yarn count, cloth count, cloth thickness and cloth stiffness. The functional properties assessed were cloth tensile strength, elongation, cloth abrasion resistance, cloth drapability and cloth pilling. The newly designed union fabrics were tested for mechanical and functional properties as per the standard methods at Central Silk Technological Research Institute, Central Silk Board, Bangalore (Table 3).

Table 3. Physical testing of Viscose Rayon and Eri silk union fabrics

| Properties | Instruments | Standard methods |
|---|---|---|
| Yarn count (Ne) | Electronic balance | BS 38-2060:1963 |
| Cloth count (numErical expression) | Pick class | - |
| Cloth thickness (mm) | Shirleys Thickness Tester | ASTM-1777:1975 |
| Cloth stiffness (cm) | Shirleys Thickness Tester | BS-3356:1961 |
| Cloth tensile strength (kgf) and and elongation (%) | Instron tensile testing machine | IS-1969:1985 |
| Cloth abrasion resistance (cycles) | Martindale's Abrasion Tester | IS-12673:1989 |
| Cloth drapability (%) | Eureka drape meter | - |
| Cloth pilling (rating) | Heal's pilling tester | IS-10971:1984 |

**Results and discussion**

The mechanical property of every woven fabric encompasses the features that provide basic texture. hand feel and dimensions to the fabric that inturn decides the functional properties of the woven fabric. Table 4 reveals that, all the union fabrics were interwoven with finer warp and coarser weft may be because of fibre content, 2 ply yarn structure and staple length of Eri silk. The control sample Viscose rayon x Viscose rayon (VR) was woven with finer warp and weft, may be due to same fibre content and filamentous yarn used which was inturn constant for all the fabrics in warp direction. Further, all the fabric samples possessed same number of ends per inch may be because of the constant features namely, fibre content, type of yarn used, reed count and the yarn count. Of all the fabric samples, the control sample, Viscose Rayon x Viscose rayon (VR) depicted greater number of picks per unit area may be because of Viscose Rayon that are finer in count/denier which inturn resulted into compact alignment of threads per unit area. Among all the union fabrics, Viscose rayon x Eri silk of 2/40s (VRE1) showed lesser number of picks per unit area which may be due to be Eri silk of 2/40s possessed coarser yarn than 2/60s and 2/80s. Further the table reports on cloth stiffness and cloth thickness of test samples. In general, the values of cloth stiffness were greater in weft direction than warp for all the union fabrics. This may be because of coarseness and heaviness of Eri silk. Among the test samples Viscose rayon x Eri silk of 2/40s (VRE1) union fabric showed highest bending path, which inturn depicted its stiffness, may be due to coarser yarn and highest values of thickness. Least bending path was exhibited by control sample, Viscose Rayon x Viscose rayon (VR) attributed to finer yarn count and least values of thickness. Thus was found to be soft and pliable.

Viscose rayon x Eri silk of 2/40s (VRE1) exhibited maximum thickness which may be due to coarser yarn count and irregular yarn surface. These findings are on par with results of Sanapapamma and Naik (2007).

Table 4. Mechanical properties of newly designed union fabrics

| Union fabrics | Direction | | Yarn count (Ne) | | Cloth count (Numerical expression) | | Cloth stiffness (cm) | | Cloth thickness (mm) |
|---|---|---|---|---|---|---|---|---|---|
| | Warp | Weft | Warp | Weft | Warp | Weft | Warp | Weft | |
| Viscose rayon x viscose rayon (control, VR) | viscose rayon | viscose rayon | 75d (71s) | 75d (71s) | 101 | 83 | 0.88 | 1.14 | 0.18 |
| Viscose rayon x Eri silk of 2/40s ($VRE_1$) | viscose rayon | eri silk | 75d (71s) | 2/40s | 101 | 51 | 1.56 | 4.98 | 0.42 |
| Viscose rayon x eri silk of 2/60s ($VRE_2$) | viscose rayon | eri silk | 75d (71s) | 2/60s | 101 | 58 | 1.22 | 2.84 | 0.31 |
| Viscose rayon x eri silk of 2/80s ($VRE_3$) | viscose rayon | eri silk | 75d (71s) | 2/80s | 101 | 72 | 1.06 | 2.78 | 0.27 |

Table 5. Cloth tensile strength, elongation and cloth a brasion resestance of newly designed union fabrics

| Union fabrics | Tensile strength (kgf) | | Elongation (%) | |
|---|---|---|---|---|
| | Warp | Weft | Warp | Weft |
| Viscose rayon x Viscose rayon (control, VR) | 58.31 | 48.89 | 76.74 | 37.64 |
| Viscose rayon x Eri silk of 2/40s ($VRE_1$) | 62.18 | 100.06 | 69.26 | 21.40 |
| Viscose rayon x Eri silk of 2/60s ($VRE_2$) | 61.58 | 65.83 | 60.64 | 19.24 |
| Viscose rayon x Eri silk of 2/80s ($VRE_3$) | 61.93 | 56.88 | 44.68 | 18.24 |

Functional properties are the product of mechanical properties where mechanical properties inturn depend upon several other factors like type of yarn,fabric geometry etc of the several functional properties specifically durability of the fabricis of prime importance. It was observed from the Table 5 that, Viscose rayon x Eri silk of 2/40s (VRE1) union fabric possessed greater tensile strength may be because of yarn composition of Eri silk, a spun silk with coarser yarn count where each constituent fibre in the yarn share more load than finer yarn, thus increasing the breaking strength of the fabric. The perusal of Table 5 also revealed about elongation of test samples. In general weft way elongation (%) was lower than warp. It was observed that Viscose rayon x Viscose (control, VR) showed higher elongation (%) may be due to fibre content of Eri silk which is considered to be more plastic than elastic. The every crystalline polymer system of Eri silk does not resist the polymer movement. On the contrary it and is possible in amorphous system. Hence, when silk is stretched additionally, the polymer, which are already in stretched state may not elongate further. Also the control sample, Viscose Rayon x Viscose rayon (VR) had better cloth sett, *i.e.* higher the threads per unit area better is the strechability. In a woven fabric, the warp threads generally have higher crimp because the filling yarns are shot straight through the shed and the warp yarns go over and under the filling yarns by the up and down motion of the harness. Hence, the warp threads strech relatively more compared to their weft. On the other hand weft-way elongation (%) was lesser among all the union fabrics because these samples were woven with spun silk yarns of lower TPI (Turns Per Inch). These findings are in line with the results of Sanapappamma and Naik (2007).

Table 6 depicts the values of cloth abrasion resistance of test samples. The relatively coarser, thicker union fabric, Viscose Rayon x Eri silk of 2/40s showed better resistance to abrasion compared to other test samples. However, the control sample, Viscose rayon x Viscose rayon (VR) exhibited low resistance to abrasion attributed to finer yarn count, low thickness value and pliable texture. On abrasion, loss in cloth thickness was found to be remarkable in union fabrics influenced by frictional abrasion in multi direction that resulted into breakage of fibre. Consequently, loss in mass was also observed. 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 in the study conducted by Joshua (1994) revealed that the continuous surface abrasion result into decrease in weight and thickness.

Table 6. Cloth abrasion resistance of newly designed union fabrics (cycles)

| Union fabrics | Number of cycles | Loss in thickness (%) | Loss in mass (%) |
|---|---|---|---|
| Viscose rayon x Viscose Rayon (control, VR) | 329 | 5.01 | 1.09 |
| Viscose rayon x Eri silk of 2/40s ($VRE_1$) | 1180 | 3.246 | 1.52 |
| Viscose rayon x Eri silk of 2/60s ($VRE_2$) | 415 | 4.87 | 2.08 |
| Viscose rayon x Eri silk of 2/80s ($VRE_3$) | 342 | 5.07 | 5.08 |

Table 7. Cloth pilling of viscose rayon and eri silk union fabrics (ratings)

| Union fabrics | Pilling (ratings) |
|---|---|
| Viscose rayon x Viscose rayon (control, VR) | 5 |
| Viscose rayon x Eri silk of 2/40s ($VRE_1$) | 4 |
| Viscose rayon x Eri silk of 2/60s ($VRE_2$) | 5 |
| Viscose rayon x Eri silk of 2/80s ($VRE_3$) | 5 |

Rating scale
1 - No pilling
2 - Slight pilling
3 - Moderate pilling
4 - Severe pilling
5 - Very severe pilling

A perusal of Table 7 illustrates 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

Table 8. Cloth pilling and cloth drape coefficient of viscose rayon and eri silk union fabrics (%)

| Union fabrics | Pilling (ratings) | Drape coefficient (%) |
|---|---|---|
| Viscose rayon x Viscose rayon (control, VR) | 5 | 64.21 |
| Viscose rayon x Eri silk of 2/40s (VRE1) | 4 | 88.58 |
| Viscose rayon x Eri silk of 2/60s (VRE2) | 5 | 87.72 |
| Viscose rayon x Eri silk of 2/80s (VRE3) | 5 | 83.23 |

| Variables | F value | Probability | SEd | CD | CV (%) |
|---|---|---|---|---|---|
| Drape coefficient (%) | 105.70** | 0.0000 | 1.567 | 3.415 | 3.062 |

** Significant at 1 per cent level of significance the test samples showed very sever pilling except Viscose rayon x Eri silk 2/40s (VRE1), showed severe pilling owing to their fibre content and yarn type. Table 8 shows drape coefficient (9%) values of Viscose rayon and Eri silk union fabrics. Drape of the fabric is related to the cloth stiffness and is influenced by various properties *viz.,* weave, cloth count, cover factor, cloth thickness etc. It is relevant from the table that control sample Viscose rayon x Viscose rayon (VR) showed least drape coefficient attributed to low bending length, low thickness, thus making it soft and pliable. However, highest drape coefficient value was observed in case of Viscose rayon x Eri silk of 2/40s (VRE1) which may be due to high bending length and thickness with greater weft-way cover factor. Thus it can be assumed that greater the stiffness, higher is the drape coefficient.

In a nut shell it is concluded that among the various test samples, Viscose rayon x Eri silk of 2/40s (VRE1) showed highest tensile strength both in warp and weft directions. The control sample, Viscose rayon x Viscose rayon (VR) showed highest elongation percentage. Viscose rayon x Eri silk of 2/40s (VRE1) union fabric exhibited highest resistance to abrasion. Almost all the fabrics showed very severe pilling. Of all the test samples, Viscose rayon x Eri silk of 2/40s (VRE) exhibited highest value of drape coefficient (%). Overall the performance of Viscose Rayon x Eri silk of 2/40s (VRE1) union fabric gave better results when compared to other test samples.

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