Comparison of Ring Spun Yarn Properties Made from Cotton and Regenerated Fibers and their Blends

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***Abstract*-Yarn properties can be altered through blending fibers. According to the requirement different properties can be achieved by different blending. [1] Among the different blends cotton & white viscose, cotton & tencel, cotton & micro modal, cotton & modal are common. Cotton & white viscose and cotton & tencel has been a popular blends now a days and depicts excellent properties than the individual yarn properties.50:50 ratio of above blending and 100% (cotton, white viscose, tencel, modal, micro modal) have been tested to observe the yarn properties. In our project we calculated the value of CV_m%, U%, neps, thick place, thin place, IPI, elongation and tenacity of each yarn. From these values we determined maximum and minimum value of each parameter of 100% fibers yarn and 50:50 ratio blend yarns individually. So we can easily find out which yarn is better for 100% yarn and 50:50 ratio blend yarn through this parameter Their blends with specific ratios exhibit excellent properties which hence ultimately contribute to the fabric properties. Their blends with specific ratios exhibit excellent properties which hence ultimately contribute to the fabric properties. [1]**

***Keywords:* Co-efficient of Variation Percentage, Uniformity percentage, Hairiness, Neps (+200%), Thick Place (+50%), Thin Place (-50%), Tenacity, Elongation Percentage, Imperfection Index (IPI).**

I. INTRODUCTION

According to W. Klein (2010) ,neither natural or man-made fibers are optimally suited to certain fields of use, but a blend of their two fibers types can gives the required characteristics. In such cases, a blending step is the obvious solution. The proportion of products made of blended yarns is therefore continually increasing. Furthermore, blending is not confined to the mixing of natural fibers with man-made fibers, blends of different types of regenerated fibers are also increasing. In central and Northern Europe, more than one-third of all fabrics produced now consists of two or three fiber components, and in the USA the proportion is much higher.[1]

The circumstances in which a blends becomes advisable and appropriate proportions depend upon the properties required in the end product. [1] From the point of view of aesthetic (visual/handle properties), the main factors are:

- Surface structure
- Luster
- Volume
- Weight
- Stiffness

The chief functional demands are:

- effectiveness for purpose
- comfort
- easy care
- physiological optimization

The economic factors are:

- use life
- price
- used value

It has been suggested by W. Klein that when two fiber components are brought together, each will contribute characteristics that are advantageous and less advantageous for the purpose. These individual characteristics exert greater or smaller influence depending upon the blend properties of the components. If both the requirements of the end product and the fiber properties are known, then the optimal blending proportions can be approximately determined. [1]

Objectives of the Study

We have chosen these topics because to compromise of ring spun yarns properties which are made from cotton and regenerated fibers and their blends. We discuss about the properties of 100% (cotton, white viscose, tencel, modal, micro modal) yarn and 50:50 ratio of (cotton + white viscose, cotton + tencel, cotton + modal, cotton + micro modal) blend yarns. These properties are CV_m%, u%, thick place, thin place, neps, hairiness, tenacity and elongation.

Previous Work Review

Comparison of mechanical and thermal comfort properties of tencel blended with regenerated fibers and cotton woven fabrics (AUTEX Research Journal, Vol. 19, No 1, March 2019, DOI: 10.1515/aut-2018-0035 © AUTEX).Here they found that blend yarns quality is better than 100% cotton.

Modal–cotton fiber blend ratio and ring frame parameter optimization through the taguchi method (AUTEX Research Journal, Vol. 19, No 1, March 2019, DOI: 10.1515/aut-2018-0036 © AUTEX) .They found that blended yarn quality depends on top roller parameter and break drafting ring frame.

Effect of fiber blend ratio on yarn properties (International Journal of Scientific Engineering and Technology, Volume

No.4 Issue No.4, pp: 243-246) .It shows that individual yarn properties are less quality than blend yarn.

From above finding research papers it is shown that blend yarn quality properties are good quality than individual yarn. Yarn quality also depends on setting parameter of different machine parts.

In our project we calculated the value of CV_m%, U%, naps, thick place, thin place, IPI, elongation and tenacity of each yarn. From these values we determined maximum and minimum value of each parameter of 100% fibers yarn and 50:50 ratio blend yarns individually. So we can easily find out which yarn is better for 100% yarn and 50:50 ratio blend yarn through this parameter.

II. MATERIALS AND MATHODS

2.1 Materials: We are working with below this raw material:

Raw Materials	Yarn Count	Blending Ratio
Cotton	30's Ne	100%
White Viscose	30's Ne	100%
Tencel	30's Ne	100%
Modal	30's Ne	100%
Micro modal	30's Ne	100%
Cotton + White Viscose	30's Ne	50%+50%
Cotton + Tencel	30's Ne	50%+50%
Cotton +modal	30's Ne	50%+50%
Cotton + micro modal	30's Ne	50%+50%

2.2 Methods:

Sample Preparation:

2.2.1 Bale Management and Blow Room Section:

There are different types of bale management system. Such as ……..Among those we use

Uniflock: It is the bale breaking and opening machine. This machine takes the fiber materials gently and efficiently from bale at micro tufts size and supplies to the next machine. [2]

Uniclean: It is a coarse cleaning machine. Trash, dust, foreign materials of fibers are separated by this machine. [2]

Unimix: It is a mixing machine of 6 to 8 chute chambers into which the output materials of uniclean is blown. This gives a uniform long term mixing or blending of fibers. [2]

Uniflex: It is a fine cleaning machine. Mixed fiber is fed to the machine for intensive cleaning. Tuft of fibers are converted into very small size. [2]

2.2.2 Carding Section:

This is the process by which fibers are prepared to manufacture yarn. In this process fiber are opened almost single (individual), removal of dust, trash, naps, and short fibers to produce a continuous strand of fiber called sliver .This machine is called mother or heart of spinning because disentanglement, cleaning and intermixing of fibers are happened here. [2]

2.2.3 Draw Frame Section:

It is a process in which slivers are blended, doubled, levelled, and elongated at certain level by passing through pairs of rollers, each pair of roller is faster than the previous one. The main tasks of draw frame are parallizing, equalizing, blending and dust removing. [2]

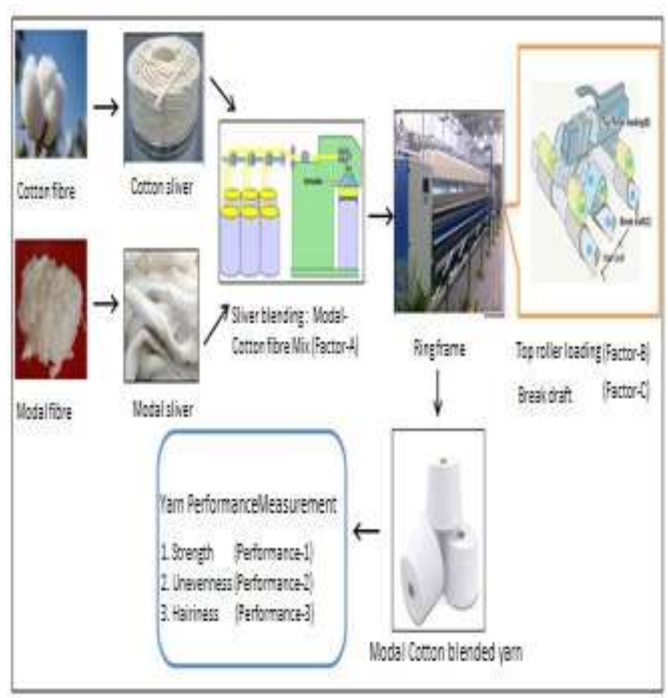
2.2.4 Simplex:

Simplex is necessary to manufacture ring spun yarn for the following two reason

a) Roving is produced from simplex machine which is appropriate to feed ring frame instead of drawn sliver.
b) Roving is 10 to 15 times finer than sliver so ring frame is capable to apply appropriate draft to manufacture required fineness yarn. [2]

2.2.5 Ring Spinning:

It is the machine by which yarn is manufactured at required specification for specific purposes. This machine is more productive, simpler in mechanism, easier in manipulation and more economic. [2]



Modal–cotton blended yarn preparation in ring spinning process is given below for an example:

Figure 2.1: Modal–cotton blended yarn preparation in ring spinning process. [3]

Here we have followed the following process sequences for producing combed yarn, given below:

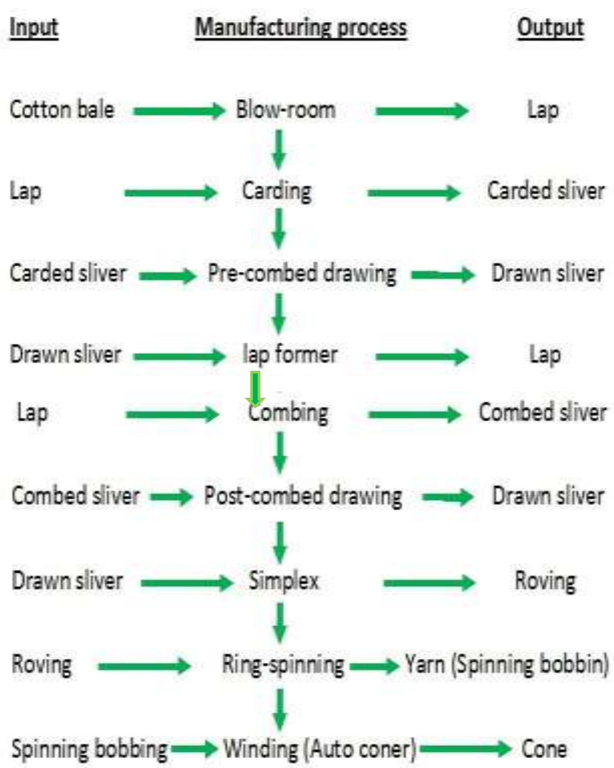


Figure 2.2: yarn preparation in ring spinning process. [4]

2.2.6 Yarn Test Experiments:

We have tested many quality parameters to carry on our project work successfully. For testing these quality parameters, we have used many machines such as:

- USTER TESTER,
- HVI,
- Single Yarn Tester
- Bundle yarn Tester
- Neps and Trash Indicator etc.

With the help of these machines, we have tested the following quality parameters such as

- Co-efficient of Variation Percentage
- Uniformity percentage,
- Hairiness,
- Neps (+200%),
- Thick Place (+50%),
- Thin Place (-50%),
- Tenacity,
- Elongation Percentage,
- Imperfection Index (IPI).

Uster tester (Uster Evenness Tester) and Electronics skein strength tester. The instrument or M/C, Uster Evenness Tester or *USTER@ TESTER 5-S400* is used to measure or calculate the unevenness (U %), co-efficient of variation of mass (CV_m %), imperfection index (IPI), thick place, thin place, hairiness, neps, tenacity and elongation etc. of yarn.

The evenness of yarn is an important index of quality control of textiles, so the researches about the yarn evenness test method have been the hotspot in the textile measurement for recent years. The evenness of yarn is one of main indexes to measure the quality of yearns. The unevenness of yarns will deteriorate the mightiness of yarns, and increase the end breakage rate in the spinning, and the increase of the end breakage rate will directly limit the speed of the machines and reduce the productivity. In addition, the unevenness of yarns will seriously influence the appearance quality of textiles. [1]

Raw material as well as spinning problem can be detected by the measurement of yarn unevenness which is done by Uster evenness tester or uster tester-5. The quality parameter is determined by a capacitive sensor. In this case the yarn, roving or sliver is passed through the electric field of a measuring capacitor. Mass variation of the material causes the disturbance of the electric field which is converted into electric signal. That is proportional to the mass variation of the material. The unevenness is recorded as a diagram. Hairiness is a measure of the amount of fibers protruding from the structure of the yarn. In the past, hairiness was not considered so important. But with the advent of high-speed looms and knitting machines, the hairiness has become a very important parameter. Modal–cotton blended yarn preparation in ring spinning process is given below for an example. [1]

During our project work, we found the following:

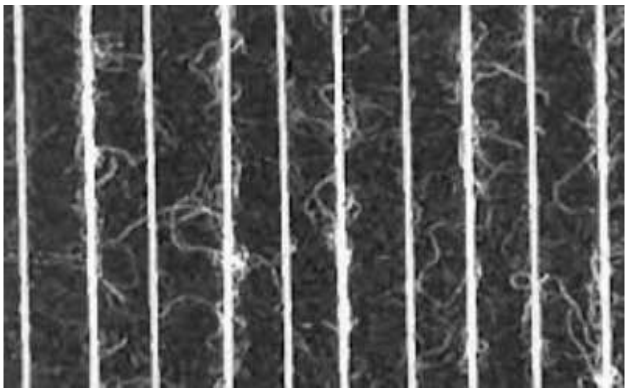


Figure 2.3 Hairiness of yarn. [5]

In general, yarn spun with Indian cotton show high level of hairiness due to the following reasons. [1]

- High short fiber content in mixing.
- Low uniformity ratio.
- High spindle speeds.

Hence most of the Indian yarns have a hairiness index above 50% Uster standards. Uster Hairiness Index is the common method followed in India. The hairiness index H corresponds to the total length of protruding fibers within the measurement field of 1cm length of the yarn. Uster hairiness index give the total length of hairs. The general definition of neps is ‘hopelessly entangled masses of fibers (figure-2.4).The appearance of common neps on yarns is shown in (figure-2.5). If neps are incorporated into the yarn, it is quite likely they will survive into the fabric. Generally, if neps exceed a fairly low threshold, the resulting fabric is not suitable for high-value textile products. Thin place and thick place were measured per kilo. [1]

Elongation percentage and Tenacity were also measured by Electronic skein strength tester

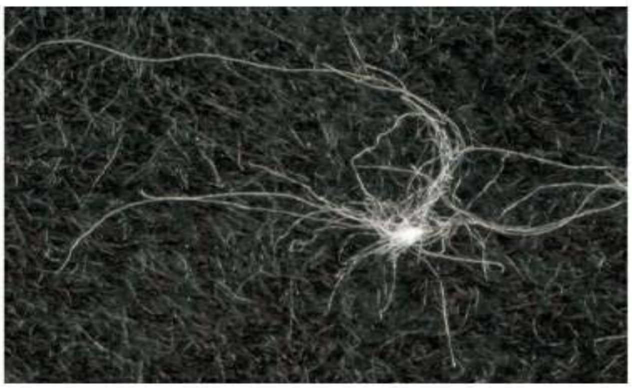


Figure 2.4: A nep in the raw cotton

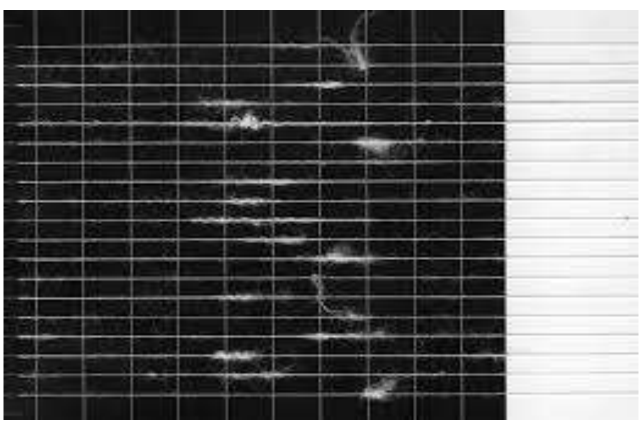


Figure 2.5: Neps in the yarn

We have calculated the hairiness and unevenness of selected samples; shown below 30’s count individual yarn and their blends with same blend ratio (50:50). Uster evenness tester will count unevenness (U %), yarn hairiness, imperfection index, and thick and thin place, neps, elongation and tenacity. [6]- [10]

III. RESULTS AND DISCUSSION

Co-efficient of Variation: CVm% means the Co-efficient of variation on mass. It indicates the quality of yarn. The higher the value of CV %, the poorer the quality of that yarn.

Table 3.1: CV_m% for 30 Ne count of individual and their blended yarn.

Raw Materials	Yarn Count	Blending Ratio	CV_m%
Cotton	30’s Ne	100%	4.69
White Viscose	30’s Ne	100%	3.42
Tencel	30’s Ne	100%	3.51
Modal	30’s Ne	100%	3.25
Micro modal	30’s Ne	100%	3.37
Cotton + White Viscose	30’s Ne	50%+50%	4.45
Cotton + Tencel	30’s Ne	50%+50%	4.27
Cotton + modal	30’s Ne	50%+50%	4.04
Cotton + micro modal	30’s Ne	50%+50%	3.43

The above information can be seen through the following Figure which is more suitable for comparison.

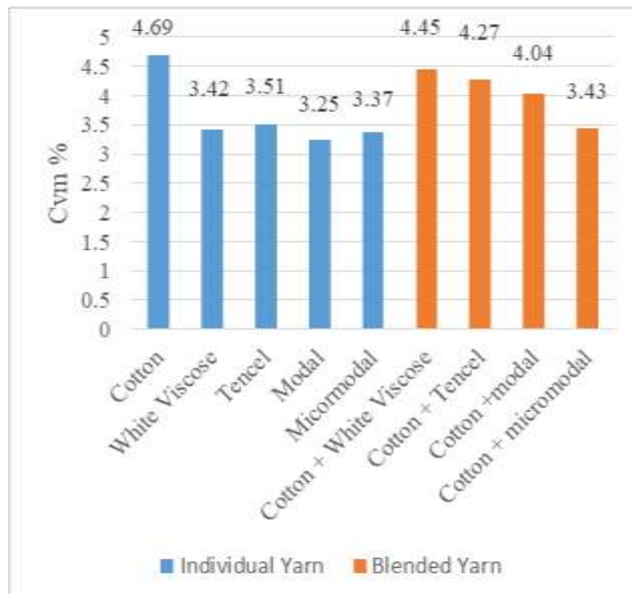


Figure 3.1: Co-efficient of variation on Mass with Cut Length 1 Meter of different yarn.

From the (Figure 3.1) we have found that

- For 100% Cotton, White Viscose, Tencel, Modal, Micro modal Yarn, the coefficient of variation on mass for 100% cotton yarn is maximum and minimum is modal.
- For 50:50 Blended Yarn, the maximum value for (cotton: tencel) and minimum value for (cotton: Micro modal) yarn.

Unevenness: It also indicates the quality of yarn. The higher the value of U%, the poorer the quality of that yarn.

Table 3. 2: Unevenness or U% for 30 Ne Count of different Yarn.

Raw Materials	Yarn Count	Blending Ratio	U%
Cotton	30's Ne	100%	10.54
White Viscose	30's Ne	100%	8.32
Tencel	30's Ne	100%	8.68
Modal	30's Ne	100%	8.13
Micro modal	30's Ne	100%	7.93
Cotton + White Viscose	30's Ne	50%+50%	9.75
Cotton + Tencel	30's Ne	50%+50%	9.59
Cotton +modal	30's Ne	50%+50%	9.41
Cotton + micro modal	30's Ne	50%+50%	8.70

The above information can be seen through the following Figure which is more suitable for comparison.

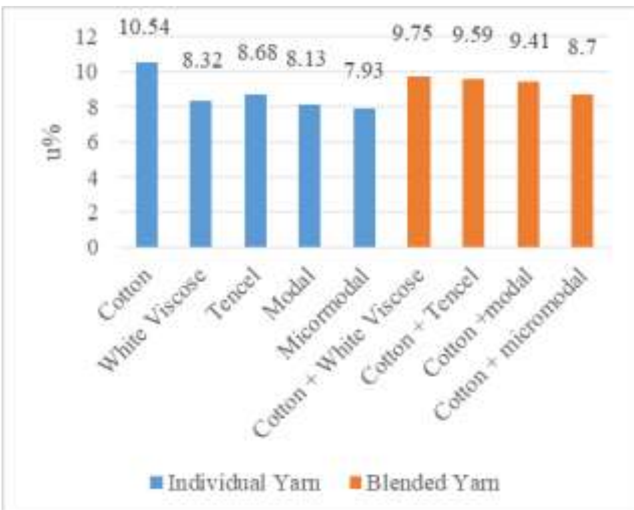


Figure 3.2: Un-evenness of different Yarn of 30 Ne count.

From the (Figure 3.2) we have found that

- For 100% Yarn, the coefficient of variation on mass for 100% cotton yarn is maximum and minimum is Micro modal.
- For 50:50 Blended Yarn, the maximum value for (cotton: white viscose) and minimum value for (cotton: Micro modal) yarn.

Hairiness: Hairiness means the protruding fibers loops (from the surface of yarn) and loosely wrapped wild fibers.

Table 3.3: Hairiness for same count of individual and their blended yarn

Raw Materials	Yarn Count	Blending Ratio	Hairiness
Cotton	30's Ne	100%	5.42
White Viscose	30's Ne	100%	4.35
Tencel	30's Ne	100%	4.56
Modal	30's Ne	100%	4.56
Micro modal	30's Ne	100%	5.97
Cotton + White Viscose	30's Ne	50%+50%	5.01
Cotton + Tencel	30's Ne	50%+50%	5.02
Cotton +modal	30's Ne	50%+50%	5.54
Cotton + micro modal	30's Ne	50%+50%	4.90

The above information can be seen through the following Figure which is more suitable for comparison.

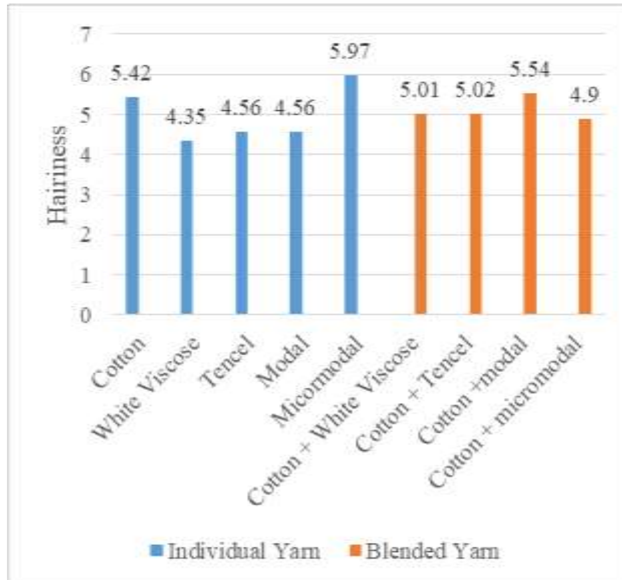


Figure 3.3: Hairiness for 30 Ne count of individual and their blended yarn.

From the (Figure 3.3) we have found that

- For 100% Yarn, the hairiness for 100% Micro modal yarn is maximum and minimum is White viscose.
- For 50:50 Blended Yarn, the maximum value for (cotton: Modal) and minimum value for (cotton: white viscose) yarn.

Neps: Neps can be defined as a small knot of entangle fibre consisting either entirely of fibers or of foreign matters entangle with fibers.

Table 3.4: Neps for same count of individual and their blended yarn.

Raw Materials	Yarn Count	Blending Ratio	Neps(+200%)
Cotton	30's Ne	100%	76.4
White Viscose	30's Ne	100%	15.0
Tencel	30's Ne	100%	7.8
Modal	30's Ne	100%	9.0
Micro modal	30's Ne	100%	95
Cotton + White Viscose	30's Ne	50%+50%	35.0
Cotton + Tencel	30's Ne	50%+50%	131.3
Cotton +modal	30's Ne	50%+50%	35.3
Cotton + micro modal	30's Ne	50%+50%	120

The above information can be seen through the following Figure which is more suitable for comparison

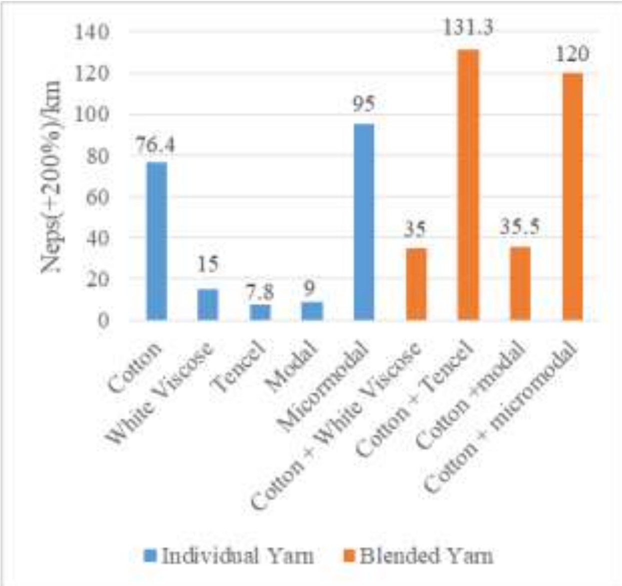


Figure 3.4. Neps for 30Ne count of individual and their blended yarn.

From the (Figure 3.4) we have found that

- For 100% Yarn, the Neps (+200%)/km for 100% Micro modal yarn is maximum and minimum is Tencel.
- For 50:50 Blended Yarn, the maximum value for (cotton: Tencel) and minimum value for (cotton: White Viscose) yarn.

Thick Place: When the diameter of yarn is greater than the original diameter, it is called thick place.

Table 3.5: Thick for same count of individual and their blended yarn.

Raw Materials	Yarn Count	Blending Ratio	Thick Place (50%)/km
Cotton	30's Ne	100%	95.8
White Viscose	30's Ne	100%	6.3
Tencel	30's Ne	100%	2.8
Modal	30's Ne	100%	3.8
Micro modal	30's Ne	100%	22.5
Cotton + White Viscose	30's Ne	50%+50%	33.8
Cotton + Tencel	30's Ne	50%+50%	65.6
Cotton +modal	30's Ne	50%+50%	24.1
Cotton + micro modal	30's Ne	50%+50%	30

The above information can be seen through the following figure which is more suitable for comparison.

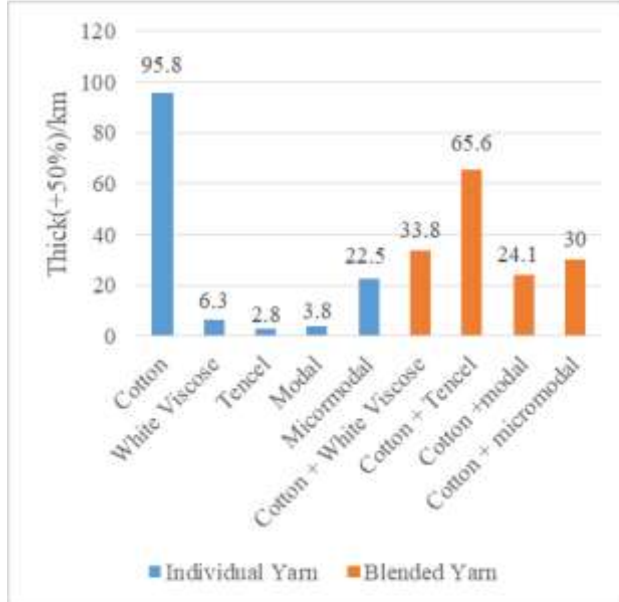


Figure 3.5: Thick place for 30 Ne count of individual and their blended yarn.

From the (Figure 3.5) we have found that

- For 100% Yarn, the Thick (+50%)/km for 100% Cotton yarn is maximum and minimum is Tencel.
- For 50:50 Blended Yarn, the maximum value for (cotton: Tencel) and minimum value for (cotton: modal) yarn.

Thin Place: It indicates the narrower diameter than the original diameter.

Table 3.6: Thin place for 30 Ne count of individual and their blended yarn.

Raw Materials	Yarn Count	Blending Ratio	Thin(-50%)/km
Cotton	30's Ne	100%	0.3
White Viscose	30's Ne	100%	0.0
Tencel	30's Ne	100%	0.0
Modal	30's Ne	100%	0.3
Micro modal	30's Ne	100%	0.0
Cotton + White Viscose	30's Ne	50%+50%	0.0
Cotton + Tencel	30's Ne	50%+50%	0.9
Cotton +modal	30's Ne	50%+50%	0.0
Cotton + micro modal	30's Ne	50%+50%	0.0

The above information can be seen through the following Figure which is more suitable for comparison.

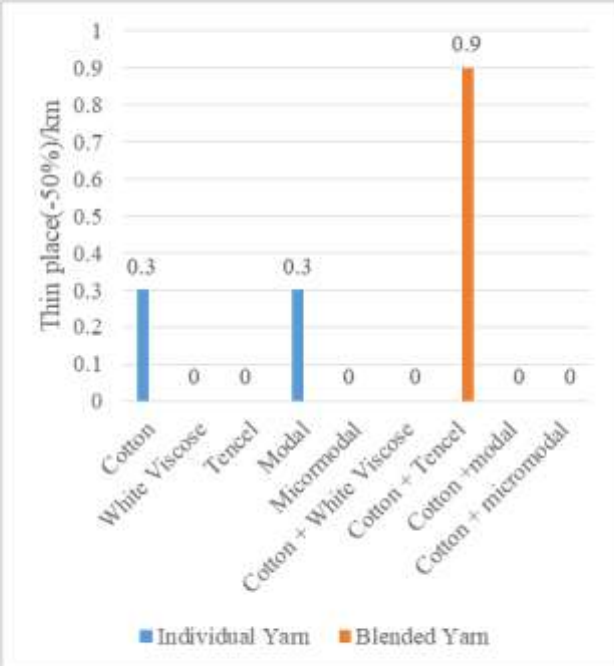


Figure 3.6: Thin place for 30 Ne count of individual and their blended yarn.

From the (Figure 3.6) we have found that

- For 100% Yarn, the Thin place(-50%)/km for 100% Cotton and Micro modal yarn is maximum and minimum is White viscose, Tencel and Micro modal.
- For 50:50 Blended Yarn, the maximum value for (cotton: Tencel) and minimum value for (cotton: modal), (Cotton: white viscose), (Cotton: modal), (Cotton: Micro modal) yarn.

Tenacity: Tenacity means the required force per tex to break the yarn vertically.

Table 3.7: Tenacity for same count of individual and their blended yarn

Raw Materials	Yarn Count	Blending Ratio	Tenacity (RKM)
Cotton	30's Ne	100%	14.776
White Viscose	30's Ne	100%	18.34
Tencel	30's Ne	100%	28.698
Modal	30's Ne	100%	15.56
Micro modal	30's Ne	100%	15.45
Cotton + White Viscose	30's Ne	50%+50%	12.852
Cotton + Tencel	30's Ne	50%+50%	21.021
Cotton +modal	30's Ne	50%+50%	15.883
Cotton + micro modal	30's Ne	50%+50%	15.779

The above information can be seen through the following Figure which is more suitable for comparison.

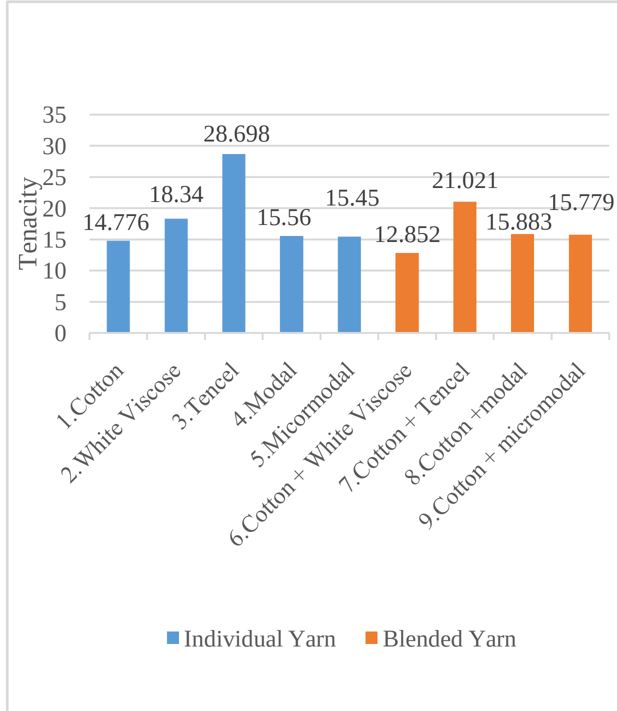


Figure 3.7: Tenacity for 30 Ne count of individual and their blended yarn.

From the (Figure 3.7) we have found that

- For 100% Yarn, the Tenacity for 100% Tencel yarn is maximum and minimum is Cotton.
- For 50:50 Blended Yarn, the maximum value for (cotton: Tencel) and minimum value for (cotton: White viscose) yarn.

Elongation: Elongation means the measurement of extension of length before breaking of yarn. It is expressed in percentage.

Table 3.8: Elongation for 30 Ne count of individual and their blended yarn

Raw Materials	Yarn Count	Blending Ratio	Elongation (%)
Cotton	30's Ne	100%	4.586
White Viscose	30's Ne	100%	13.608
Tencel	30's Ne	100%	10.199
Modal	30's Ne	100%	6.70
Micro modal	30's Ne	100%	6.55
Cotton + White Viscose	30's Ne	50%+50%	5.094
Cotton + Tencel	30's Ne	50%+50%	7.890
Cotton +modal	30's Ne	50%+50%	5.733
Cotton + micro modal	30's Ne	50%+50%	5.016

The above information can be seen through the following Figure which is more suitable for comparison.

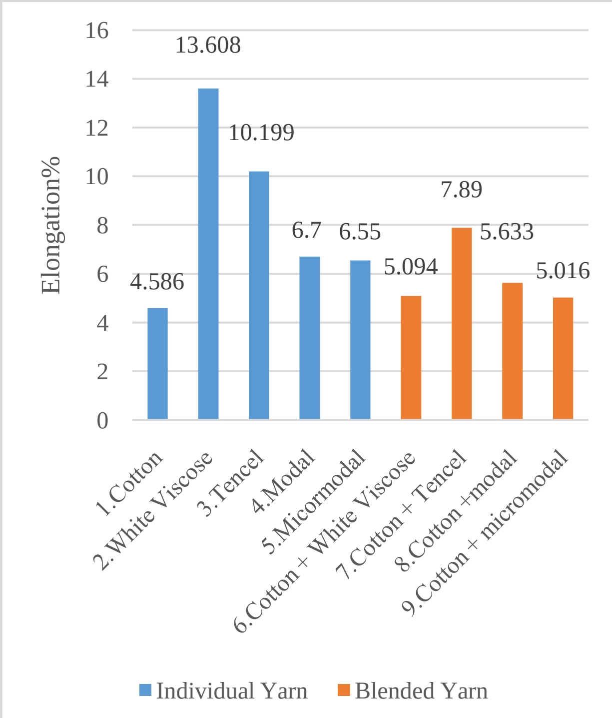


Figure 3.8: Elongation for 30 Ne count of individual and their blended yarn.

From the (Figure 3.8) we have found that

- For 100% Yarn, the Elongation for 100% White viscose yarn is maximum and minimum is Cotton.
- For 50:50 Blended Yarn, the maximum value for (cotton: Tencel) and minimum value for (cotton: micro modal) yarn.

Imperfection Index: IPI means the imperfection index. It is constituted with thick place, thin place and Neps.

Table 3.9: IPI for same count of individual and their blended yarn.

Raw Materials	Yarn Count	Blending Ratio	IPI
Cotton	30's Ne	100%	172.5
White Viscose	30's Ne	100%	21.3
Tencel	30's Ne	100%	10.6
Modal	30's Ne	100%	13.1
Micro modal	30's Ne	100%	117.5
Cotton + White Viscose	30's Ne	50%+50%	68.80
Cotton + Tencel	30's Ne	50%+50%	197.8
Cotton +modal	30's Ne	50%+50%	59.4
Cotton + micro modal	30's Ne	50%+50%	150

The above information can be seen through the following Figure which is more suitable for comparison.

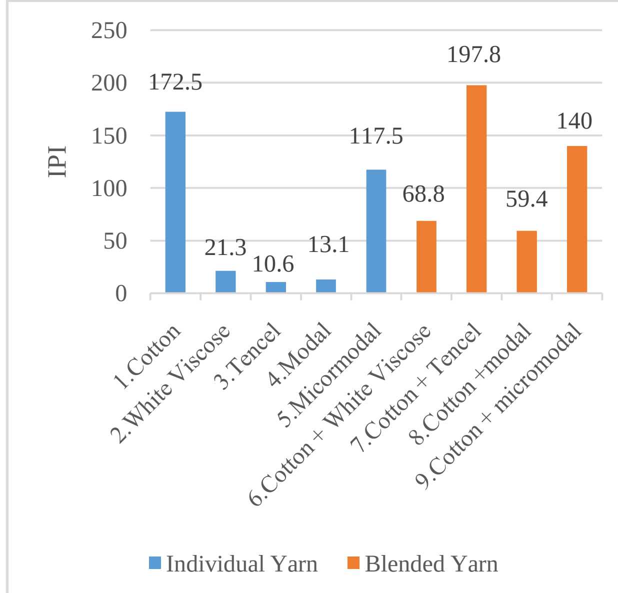


Figure 3.9: IPI for 30 Ne count of individual and their blended yarn.

From the (Figure 3.9) we have found that

- For 100% Yarn, the IPI for 100% Cotton yarn is maximum and minimum is Tencel.
- For 50:50 Blended Yarn, the maximum value for (cotton: Tencel) and minimum value for (cotton: modal) yarn.

IV. CONCLUSION

In our project we calculated the value of CV_m%, U%, neps, thick place, thin place, IPI, elongation and tenacity of each yarn. From these values we determined maximum and minimum value of each parameter of 100% fibers yarn and 50:50 ratio blend yarns individually. So we can easily find out which yarn is better for 100% yarn and 50:50 ratio blend yarn through this parameter Their blends with specific ratios exhibit excellent properties which hence ultimately contribute to the fabric properties. From the above experiment we can easily identify the following results. For single Yarn 100% Tencel yarn is better (Considering Neps, Thick Place, Thin Place, Tenacity and IPI). For 50:50 blended ratio-cotton: Micro modal is better (Considering CV_m%, U%, Hairiness, Thick Place, Thin Place). At the end, Comparing single yarn and blended yarn, 50:50 blended ratio of (Cotton: Micro modal) yarn is better. [11]

ACKNOWLEDGMENT

We are very great full to "NZ Textiles Ltd." For giving chance to do our experiment by using their instruments and machineries.

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