Research Article

Statistical analysis of fiber quality to obtain a correlation between the fiber and yarn quality

Abstract

The purpose of this research was to make a correlation between the fiber and yarn quality based on different properties of the fiber. The properties of cotton fiber were tested by the High Volume Instrument (HVI) machine. Firstly, we collect fiber from a different lot and then tested the properties by the High Volume Instrument (HVI) Machine. After that, we made yarn from that lot and made the same count of yarn. The tested properties were mic, length, maturity, strength, elongation, moisture, etc. The same count of yarn was tested by the USTER EVENESS TESTER machine. Comparing the HVI report and the USTER TESTER report, we saw that how to effect different fiber properties of the different lot on the same count of yarn quality. Then we made a correlation between them. The observation suggested that yarn strength and fineness are depended upon fiber maturity. This paper reports a glimpse of the effect of fiber properties on yarn quality.

Keywords: HVI machine, uster tester 5, lea strength tester, yarn quality, fiber properties

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Introduction

Textile fiber is the raw material to produce various types of textile finished products.[1] A fiber that can be spun into yarn or processed into textiles such as woven, knit, lace, felt, non-woven, etc.by utilizing an appropriate interlacing method is called textile fiber.[2,3] Cotton cultivating country-Australia, China, India, USA, Pakistan, Africa, Nigeria, Uzbekistan, Kazakhstan, Bangladesh, etc. Fiber property varies from country to country.[4,5] Fiber properties are testing by the HVI machine.[6,7] HVI means a High Volume Instrument. Yarn is a continuous strand of fiber. It is a substantial length that has a small cross-section with or without the twist. Yarn properties are tested by Uster Tester and Strength Tester.[8,9] Yarn quality depends, most nylon fiber quality.[10,11]

Aim of the research

The research aims to understand the relation between the fiber and yarn quality very well and to study them. This would be beneficial for the productivity of good and qualified yarn. By learning it properly, it can be possible that we use less good fiber and can produce quality full yarn.

Research objectives

a. To know about the fiber quality.

b. To know about the relation between fiber property and yarn quality.

c. To analyze the various types of report.

d. To analyze the HVI report.

e. To analyze the USTER EVENESS tester report.

f. To analyze the U%, CVm%, imperfection, hairiness.

g. To analyze the IPI value of report.

h. To learn how to do project work & make report.

Literature review

Yarn quality depends on fiber properties, the testing of fibers was always of importance to the spinner. It is done by the HVI machine.

High volume instrument systems are based on the fiber bundle strength testing, i.e. many fibers are checked at the same time and their average values are determined. Traditional testing using micronaire, pressley, stelometre, and fibro graph is designed to determine the average value for a large number of fibers, the so-called fiber bundle tests.[12,13] In HVI, the bundle testing method is automated. Here, the time for testing is less and so the number of samples that could be processed is increased, quite considerably. The influence of the operator is reduced.[14,15] Following properties of the fiber are testing HVI machine:

i. Micronaire (mic)

ii. Upper half mean length (Len)

iii. Uniformity index (Unf)

iv. Short fiber index (SFI)

v. Strength (Str)

vi. Elongation (Elg)

vii. Moisture (moist)

viii. Reflectence (Rd)

ix. Yellowness (+b)

x. Color grade (C Grade)

xi. Trush count (Tr count)

xii. Trush Area (Tr area)

xiii. Trush Grade (Tr Grade)

xiv. Neps (Nep)

xv. Spinning consistency index (SCI)

Methodology

We had continued our thesis step by step. We have taken decision that we will continue our thesis through the following steps:

a. We collected fibers from different lots of same or different countries.

b. We had tested the fibers with HVI machine

c. We had selected at least three properties from HVI properties.

d. We had produced same count yarn from different lots.

e. We had tested those yarn properties by the Evenness tester, lea strength tester etc.

It will be recorded every step and its results on Microsoft words and statically data may would be record Microsoft excel.

Material & equipment

Material: 100% cotton (Indian) is used for this experiment.

Equipment: The following equipment's are used to complete this experiment:

i. USTER AFIS Pro

ii. USTER HVI Spectrogram

iii. USTER Tester 5

iv. Lea strength tester

Research limitations

During this research, at first, we wanted to call fixed value mic, length, strength, naps. But it is quite impossible because in every laydown or in a bale there is various fiber with different parameters, but they are nearly similar and they always use an average value of mic, naps, length, strength. We were also done that. Another limitation is the shortage of proper lab facilities. We were internship students. We didn't have proper access to the lab and testing machinery. Our research duration was the entire final year, but originally, we have done it within only one month. Because on our campus we were not provided with the necessary types of machinery and the components. In our internship period, we had only 9 days for our Qc department and that was only the time we got for our research. Though there were limitations we had given our best effort to complete our research.

Result and discussion

Relation between micronaire and count strength product

This graph shows a state line which is created by relation between CSP value and MIC value. By this graph we see that if MIC value is increasing the CSP value is decrease (Figure 1).
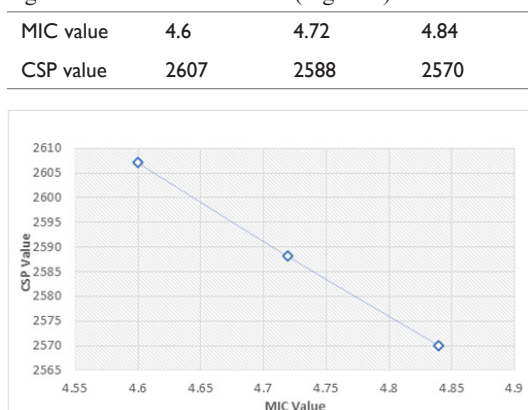
MIC value	4.6	4.72	4.84
CSP value	2607	2588	2570

Figure 1 Relation between micronaire and count strength product in line graph.

Relation between naps in fiber and naps in yarn

The graph shows a state line which is created by relation between naps in fiber and naps in yarn. By this graph we see that if naps in fiber are high the naps in yarn are high (Figure 2).
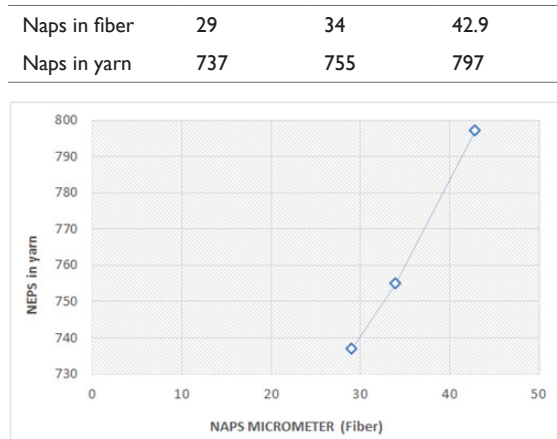
Naps in fiber	29	34	42.9
Naps in yarn	737	755	797

Figure 2 Relation between naps in fiber and naps in yarn in line graph.

Relation between fiber length and imperfection index

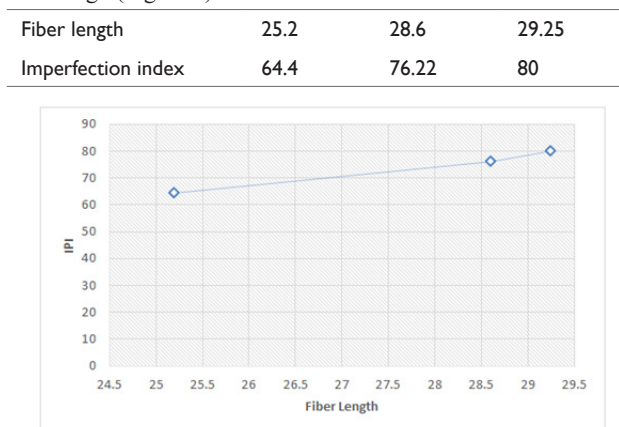By this graph we see that if fiber length is high the imperfection index is high (Figure 3).

Fiber length	25.2	28.6	29.25
Imperfection index	64.4	76.22	80

Figure 3 Relation between fiber length and imperfection index in line graph.

Relation between length of fiber and hairiness of yarn

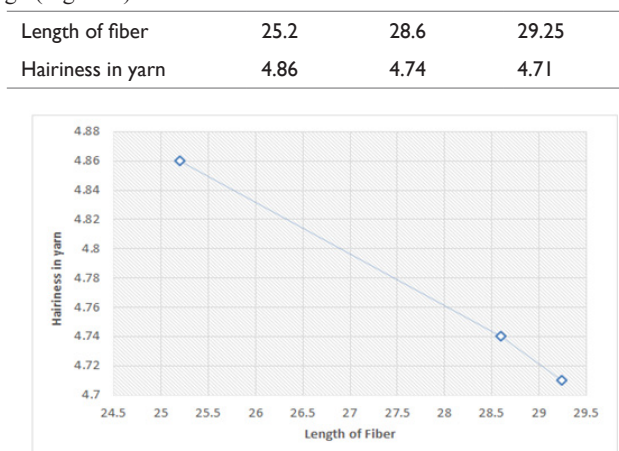By this graph we see that if the fiber length is high the hairiness is high (Figure 4).

Length of fiber	25.2	28.6	29.25
Hairiness in yarn	4.86	4.74	4.71

Figure 4 Relation between length of fiber and hairiness of yarn in line graph.

Relation between maturity of fiber and co efficient variation of yarn

By this graph we see that if maturity is high the co efficient variation of yarn is low (Figure 5).

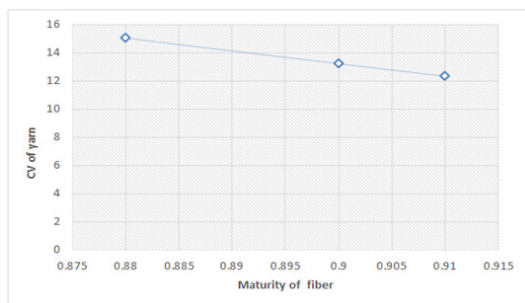| Maturity of fiber	0.89	0.9	0.91
CV of yarn	15.03	13.2	12.31

Figure 5 Relation between maturity of fiber and co efficient variation of yarn in line graph.

Relation between maturity of fiber and neps per kilometer

By this graph we see that maturity of fiber is increase the neps in yarn is decrease (Figure 6).

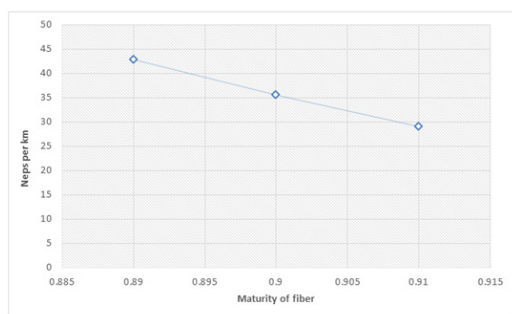| Maturity of fiber	0.89	0.9	0.91
Neps per km	42.9	35.6	29

Figure 6 Relation between maturity of fiber and neps per kilometer in line graph.

Relation between elongation of fiber and count strength product

By this graph we see that if elongation of fiber is increasing the CSP is increase (Figure 7).

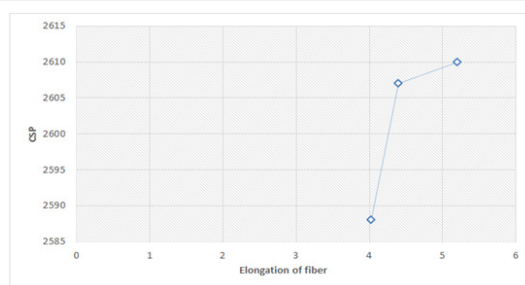| Elongation of fiber	4.02	4.4	5.2
Count strength product	2588	2607	2610

Figure 7 Relation between elongation of fiber and count strength product in line graph.

Relation between short fiber contain and imperfection index

By this graph we see that if short fiber content increase then imperfection index increases (Figure 8).

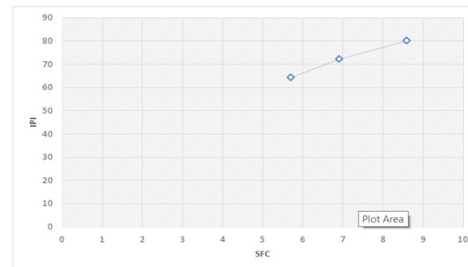| Short fiber contains	5.7	6.91	8.6
Imperfection index	64.4	72.22	80

Figure 8 Relation between short fiber contain and imperfection index in line graph.

Relation between short fiber contain and hairiness of yarn

By this graph we see that if short fiber content increase then hairiness also increases (Figure 9).

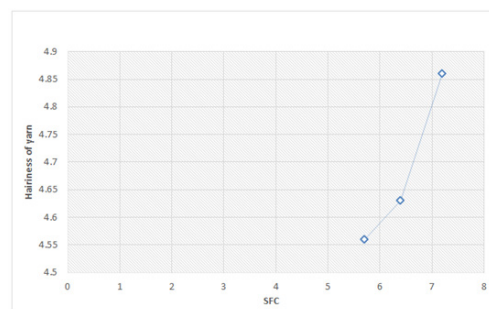| Short fiber contains	5.7	6.4	7.2
Hairiness of yarn	4.56	4.63	4.86

Figure 9 Relation between short fiber contain and hairiness of yarn in line graph.

Relation between fiber strength and count strength product

By this graph we see that if fiber strength increases then CSP increases (Figure 10).

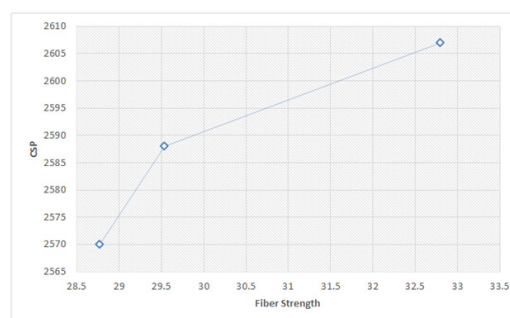| Fiber strength	28.77	29.54	32.8
Count strength product	2570	2588	2607

Figure 10 Relation between fiber strength and count strength product in line graph.

Conclusion

This project works about the effect of fiber properties on yarn quality. For this project, we collect the HVI value of fiber such as Mic, length, strength, maturity, naps, SCI, SFI, elongation, +b, Rd, etc. We also collected USTER tester 5 reports of yarn. Such as U%, CV%, Thick, Thin, Naps, etc. According to these two reports, we try to find out the relation between fiber properties and yarn quality. We think that this research is going to be helpful for good productivity of quality full yarn from less qualified fibers and further research can bring a significant development in the spinning process.

Acknowledgments

Funding

Conflicts of interest

There is no conflict of interest in publishing articles according to the author's declaration.

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