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Research Article

A COMPARATIVE EVALUATION OF THE LOW STRESS MECHANICAL PROPERTIES COTTON/SPANDEX AND POLYESTER/SPANDEX BLEND KNITS

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ABSTRACT
The paper investigates the low stress mechanical properties of cotton/spandex and polyester blend knits. The properties considered in the study are tensile, shear, bending, and compression. Both the types of blend knits compare well in the properties investigated. In some cases polyester/spandex shows better results and others cotton/spandex give better results. Spandex content in the blend has enhanced the elongation properties.

Key Words: *Blend Knit, Compression, Extensibility, Shear Stiffness, Tensile Energy*

INTRODUCTION

Exhaustive work has been done cotton single jersey knitted fabrics and the relationship between machine and fabric parameters have been established theoretically and verified experimentally (Leticia *et al.,* 1999; Onal and Cevza, 2003; Long and Zhou, 2004; Marie *et al.,* 2004; Nuray and Seinez, 2002). Since knitting of stretch fabrics using spandex in core or plated form is gaining momentum for various end uses, it becomes necessary to study systematically the dimensional stability of spandex blended fabrics, for the purpose of estimating the finished fabric dimensions beforehand. The Polyester /spandex core single jersey knitted fabrics are produced for many applications where very high stretch is required. The process parameters influence the final dimensions of the fabrics to a great extent. Earlier studies have been directed towards comparison of the properties of polyester/spandex and cotton/spandex blend knits (Gokarneshan and Thangamani, 2010). This paper investigates the low stress mechanical properties of cotton/spandex and polyester/spandex knitted fabrics using the KAWABATA evaluation system. Important properties are tested by relevant testing methods and the results discussed herein.

MATERIALS AND METHODS

The linear densities of the polyester /spandex yarn which are currently being used in the industry have been chosen for this study. These are giving below;

- 97d Polyester/Lycra 'Power Stretch Yarn'
- 170d Polyester/Lycra 'Comfort Stretch Yarn'

Since the 97 d polyester/ spandex yarn is finer and 170d polyester/ spandex yarn is coarser, knitting machines having different gauges have been selected for knitting single jersey fabrics. For knitting 97 d Polyester /spandex yarn a knitting machine of 28 gauges was selected. For knitting 170d polyester /spandex yarn a knitting machine of 24 gauges was selected. Cotton/spandex yarns of 15 tex and 20 tex have also been used in the study. The knitting parameters are the same as in the previous case.

The low-stress mechanical properties of the cotton/spandex and polyester/spandex knitted fabrics are evaluated using Kawabata Evaluation system. The properties tested are i) Tensile, ii) Shear, iii) Bending, and iv) Compression

The tensile properties are tested using Tensile tester (KES FB-I). Shear properties are tested using shear tester (KES FB-I). Bending properties are tested using Bending Tester (KES FB-2) and Compression properties are tested using Compression tester (KES FB-3).

RESULTS AND DISCUSSION

Evaluation of Tensile Properties

The values for Linearity of load Extension Curve (LT) and tensile energy (WT) for the cotton/spandex and polyester/spandex knitted fabrics are given in and the values for tensile resilience (RT) and Extensibility (EM) are also given.

It can be observed that generally linearity of load Extension Curve (LT) for cotton / spandex as well as polyester/ spandex knitted fabrics does not change with loop length. For polyester/spandex knitted fabrics the linearity is slightly lesser than that of cotton / spandex fabrics. The difference may be due to the difference in the force –elongation curve of the individual yarns. The cotton/ spandex yarn has more or less straight force –elongation curve (Figure 1).

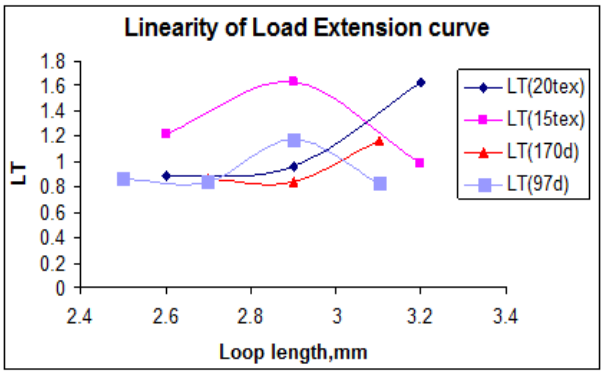

Figure 1: Linearity of load Extension Curve (LT) of cotton / spandex and polyester / spandex knitted fabrics

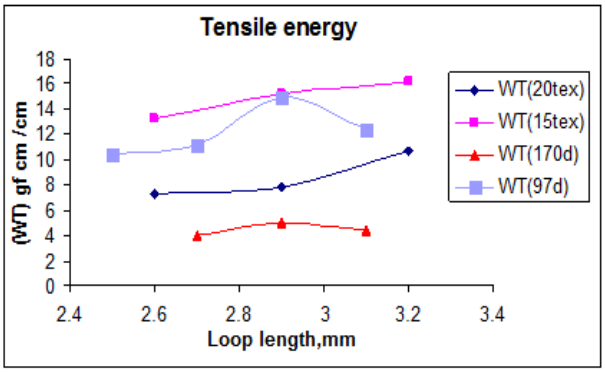

Figure 2: Tensile energy of cotton / spandex and polyester / spandex knitted fabrics

Tensile energy (WT) for all the fabrics increase with increase in loop length which is evident from Figure 2 Finer yarn fabrics have more tensile energy than course yarn fabrics.

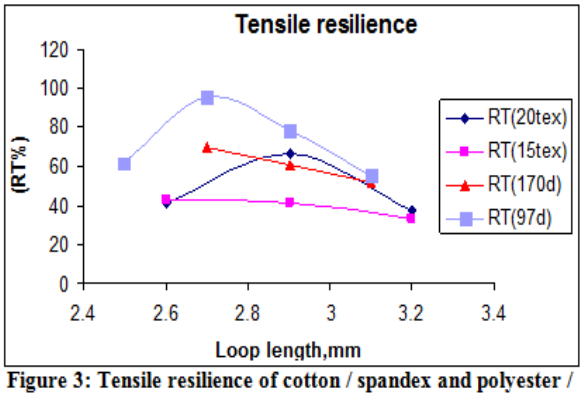

Figure 3: Tensile resilience of cotton / spandex and polyester / spandex knitted fabrics

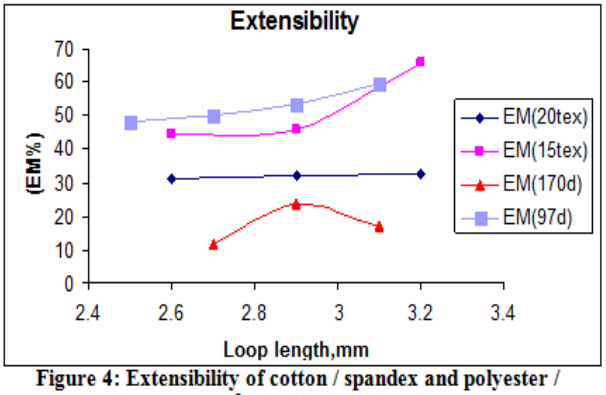

Figure 4: Extensibility of cotton / spandex and polyester / spandex knitted fabrics

From Figure 3 it can be observed that in general tensile resilience (RT) decrease with loop length in all the fabrics and Figure 4 shows that extensibility slightly increase with loop length for all the fabrics. This is because higher loop length can give more extension due to the higher loop distortion in length

direction. Further, finer yarn fabrics have more extensibility because the fine yarn fabric contains more spandex content.

Evaluation of Shear Properties

The shear stiffness and hysteresis of shear force values for cotton / spandex and polyester/spandex fabric have been evaluated. From the Figure 5 it can be observed that the shear stiffness is influenced by loop length and count of yarn. The shear stiffness decreases with increase in loop length as well as it decreases as the count becomes finer. The overall shear stiffness values for cotton / spandex fabric are more than polyester / spandex fabric. Hysteresis of shear force also follows the same tread. This can be observed from Figure 6 and Figure 7.

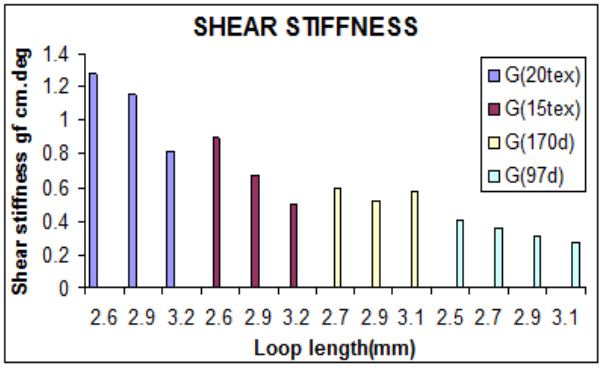

Figure 5: Shear stiffness of cotton / spandex and polyester / spandex knitted fabrics

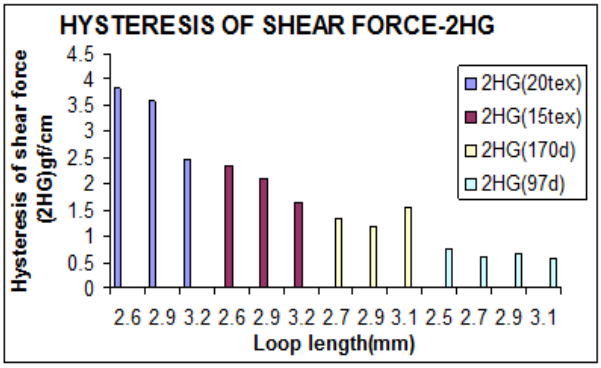

Figure 6: Hysteresis of shear force at 0.5 deg shear angle of cotton / spandex and polyester / spandex knitted fabrics

Evaluation of Bending Properties

The bending rigidity and Hysteresis of bending moment for cotton / spandex and polyester / spandex knitted fabrics have been evaluated. it can be observed that the bending rigidity decreases with increase in loop length for cotton / spandex fabrics. Finer the yarn lesser is the bending rigidity. For polyester / spandex fabrics it remains more are less same without any significant trend. Hysteresis of bending moment also follows the same trend. Which is clear from Figure 9?

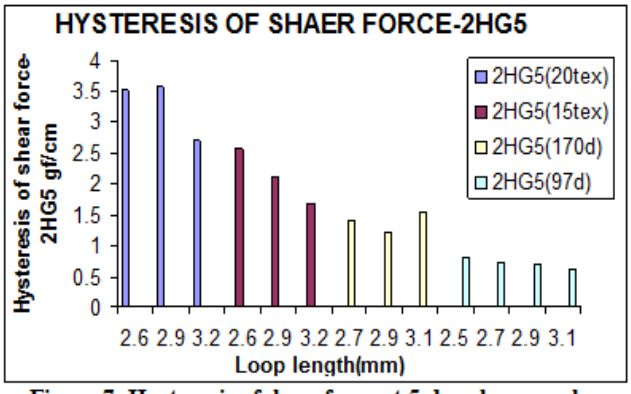

Figure 7: Hysteresis of shear force at 5 deg shear angle of cotton /spandex and polyester/spandex knitted fabrics

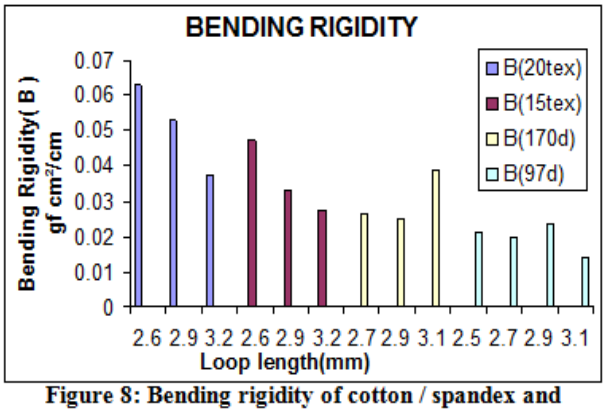

Figure 8: Bending rigidity of cotton / spandex and polyester / spandex knitted fabrics

Evaluation of Compression Properties

The linearity of Compression - Thickness curve, Compressional energy and Compressional resilience as tested in Kawabata testing system have been evaluated for cotton / spandex and polyester/spandex fabrics.

It can be observed that the linearity of Compression –Thickness curve for cotton / spandex fabrics does not show any significant trend and they vary from 0.327to 0.397 for cotton / spandex fabrics and from 0.446 to 0.487 for polyester / spandex fabrics except for the 0.31 loop length. The polyester/spandex fabrics with 0.31 loop length is very loose it behaves in a different manner.

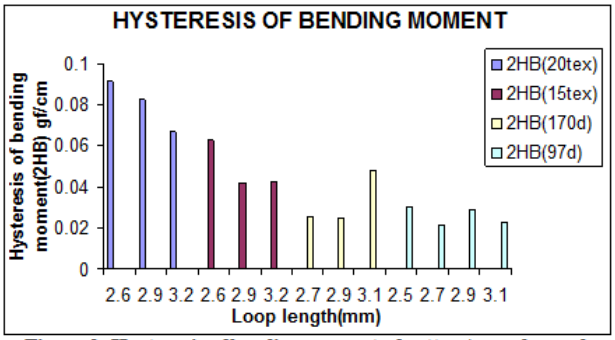

Figure 9: Hysteresis of bending moment of cotton / spandex and Polyester / spandex knitted fabrics

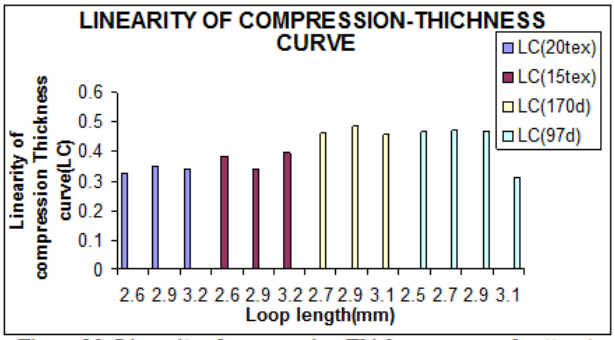

Figure 10: Linearity of compression-Thickness curve of cotton / spandex and polyester / spandex knitted fabrics

The compressional energy increase with increase in loop length for cotton / spandex fabrics and it is more for finer yarn fabrics. For polyester / spandex fabrics it remains more are less same without showing any trend. From Figure 10 and 11 it can be observed that the compression energy for polyester/spandex fabrics are less compared to cotton /spandex fabrics.

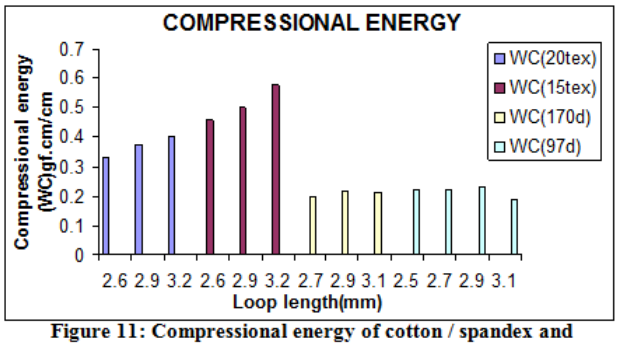

Figure 11: Compressional energy of cotton / spandex and polyester / spandex knitted fabrics

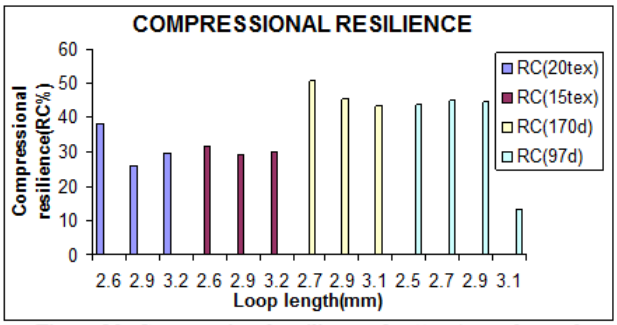

Figure 12: Compressional resilience of cotton / spandex and polyester / spandex knitted fabrics

The compression resilience for polyester / spandex fabrics is higher than for cotton / spandex fabrics by about 10-15%. The polyester / spandex fabrics are made out of high stretch filaments, hence they have more resilience. (Figure 12)

CONCLUSION

The following conclusions have been deduced from the above investigations:

- Linearity of load Extension Curve for cotton / spandex as well as a polyester / spandex fabric does not change with loop length significantly. However, the value is lesser for polyester / spandex fabrics than that of cotton / spandex fabric.
- Tensile energy for fine yarn fabrics are more than course yarn fabrics and tensile energy slightly increases with loop length.
- Tensile resilience decreases with loop length.
- Extensibility increases with loop length and fine yarn fabric have more extensibility than course yarn fabric because the spandex content is more.

- Shear stiffness is influenced by loop length and count of yarn. The shear stiffness decreases with increase in loop length as well as it decreases as the count becomes finer.
- The overall shear stiffness values for cotton / spandex fabric are more than polyester / spandex fabric
- Bending rigidity decreases with increase in loop length for cotton / spandex fabrics. Finer the yarn lesser is the bending rigidity. For polyester / spandex fabrics it remains more are less same without any significant trend.
- Linearity of Compression –Thickness curve for cotton / spandex as well as polyester / spandex fabrics does not show any significant trend
- The compresional energy increases with increase in loop length for cotton / spandex fabrics and it is more for finer yarn fabrics. For polyester / spandex fabrics it remains more are less same without showing any trend.
- Compression resilience for polyester / spandex fabrics are higher than for cotton / spandex fabrics

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