International Journal of Engineering & Scientific Research
Vol.6 Issue 12, December 2018,
ISSN: 2347-6532 Impact Factor: 6.660
Journal Homepage: http://esrjournal.com, Email: esrjeditor@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

CHARACTERIZATION OF YARNS PRODUCED FROM COTTON, MODAL, POLYESTER AND THEIR BLENDS

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Article Received: 25th November, 2018 Article Revised: 28th November, 2018 Article Accepted: 30th November, 2018

ABSTRACT

In the present research work, a series of blends yarns of 30s Ne (19.68Tex) using twist factor 3.7 consisting of 75/25 cotton/modal, 50/50 cotton/modal, 25/75 cotton/modal, 75/25 polyester/modal, 50/50 polyester/modal and 25/75 polyester/modal was produced and used. Besides this, 100% polyester, 100% modal and 100% cotton yarns were produced with the same particulars. An attempt is also made to find out optimum blend composition for producing netted garments (especially for sportswear and under garments) is done in this study.

Keywords: Modal, Cotton, Polyester, Blended Yarns

Introduction

Though India is one of the major producers of cotton, silk and jute fibres, the demand for the blended textile materials is always in the ascending trend. This is because of the requirements of aesthetics and comfortless by textile consumers in the world. Blended textile materials are able to meet the requirements of consumers than the products developed by individual fibres.

In the era of globalization the competition in both domestic and export apparel market will be more cut-throat. In this condition India will certainly face a stiff challenge from other

Asian countries like Chain, Taiwan, Indonesia, Sri Lanka, Pakistan and Bangladesh. To meet out such challenges of international trade, it is right time to concentrate on certain changes to keep the existing market intact and to enhance to new market avenues. The garment exports of India should give importance to the following areas.

- Product development
- Value addition by using new raw materials and the state of art technology to manufacture products.
- Improved quality by adopting quality management systems and statistical tools.
- Cost effective product.
- Adopting quick delivery schedules.

Out of the above first two will be the helpful to the garment manufactures to increase their market share and profitability to great extent.

New regenerated textile fibres produced in the chemical industry using cellulose as raw material. Regenerated cellulosic fibres include Viscose, Cuprammonium, Bamboo, Tencel and Modal. Conventional regenerated cellulosic fibres are generally produced by viscose process, while modal and tencel are produced by eco-friendly process.

Viscose production is based on deriving cellulose with carbon disulphide. Due to various environmental problems with viscose process, eco-friendly Lyocell fibres are produced using N-methylmorphelene-N-oxide (NMMO), without formation of derivatives. Differences between Viscose, Modal and Tencel (Lyocell) in their mechanical properties are attributed to the differences in crystallinity, orientation and % of void content. The structural characteristics namely molecular structure (density, degree of polymerization, molecular mass) and super molecular structure (crystallinity index, crystallite dimensions, molecular orientation and structure of voids) of these regenerated eco-friendly cellulosic fibres are quite different from that of conventional viscoserayon.

Kreze et al. (2003) have conducted extensive studies on the structural characteristics of new and conventional regenerated cellulosicfibres.

Modal is currently used in under garments accompanied with elastane fibre to provide more comfort. Tencel is used for the production of dress materials and sportswear. All the regenerated cellulosic fibres, although have the same chemical composition, differ in many physical properties which make them suitable for many applications.

Kreze et al. (2001) have co-related the structure and adsorption properties of regenerated cellulosic fibres such as Lyocell, Viscose and Modal. The structural analysis carried out by them shows that Lyocell fibre has high molecular orientation. They concluded that the adsorption properties of cellulosic fibres depend predominantly on the nature of void systems (diameter, volume and inner surface of voids) and amount of amorphous region.

Cellulosic fibres, natural as well as regenerated have a crystalline amorphous micro fibrillar structure. The differences between natural and particular type of regenerated cellulose fibres are attributed to the size of crystallites and amorphous regions, amorphous and crystalline orientations, size and shape of voids and number of inter fibrillar, lateral molecules.

In order to characterize cellulose accessibility, interaction with water is often employed which is able to destroy weaker hydrogen bonds but cannot penetrate into the regions of high order. The adsorption properties of fibres can be obtained on the basis of various methods for determining the dye, Idomine surfactantadsorption.

Kreze et al. (2001) have demonstrated that the adsorption properties of fibre forming polymers are determined by the amorphous regions, the size and organization of voids and interaction properties of the surface. It was felt that the influence of the crystalline regions, the size and orientation on the adsorption character is less important.

A considerable amount of work has been carried out on the structure property relations of Viscose, modal and lyocell fibres (Kreze et al. 2001).

Latif et al. (2018) have studied the mechanical, comfort properties of modal with cotton and regenerated fibres and blended woven fabrics. They used 100% cotton combed yarn, 100% modal yarn, 100% viscose yarn, 100% bamboo yarn, modal/viscose 50:50 blend,

Modal/bamboo 50:50 and modal/cotton 50:50.

Fabrics produced using blended yarns had plain weave and fabrics were tested for tensile, tear, air permeability, moisture management, thermal resistance and water vapor permeability. They found that 100% modal fabrics had better mechanical and comfort properties than other fabrics.

As far as blends are concerned, in particular, their mechanical properties, modal/cotton gave better tensile properties than modal/viscose and modal/bamboo fabrics.

With respect to comfort properties modal/viscose gave better air permeability than modal/cotton and modal/bamboo blended fabrics, whereas modal/cotton fabrics gave higher moisture management properties than modal/viscose and modal/bamboo fabrics.

The thermal resistance was found to be higher for modal/bamboo and modal/viscose fabrics then that of modal/cotton fabrics. Similarly modal/viscose was found to give better water vapor permeability than other blends. It can be noted that the author used only one blend ratio of modal/cotton (50:50) in their research work.

Objectives of the present research work are

1. To characterize cotton, polyester and modal fibres for various physical and mechanical properties.
2. To produce a series of blended yarns with different blend compositions and to produce yarns from 100% modal, polyester and cottonfibres.
3. To investigate the tensile properties viz, Tenacity, elongation at break, work of rupture, U% imperfections and CSP of these yarns.
4. To compare the interactions of various blends using an improved procedure and to recommend the best way of designing them.

Literature Review

Modal fibre

Modal fibre is a semi synthetic cellulosic fibre made from regenerated cellulose from beech trees. Lenzing started marketing these fibres in 1964. Modal is found to be very soft in comparison to cotton. With respect to fineness the modal fibres are comparable with fineness of silk and feel of the modal is similar to silk. Modal is 50% more hygroscopic than cotton.

Even after repeated washing modal remains to be absorbent, soft and supple. Modal fibres have been found to be having wide variety of uses in clothing outer wear and household furnishings.

Moses and Jnanapriya (2016) have carried out a study on modal fabrics treated with formic acid. They have used different concentrations of formic acid such as 1%, 2%, 3%, 4% and 5% for 30 minutes at ambient temperature.

Physical properties such as tensile strength stiffness, crease recovery angle, bursting strength and drape of these fabrics were measured. Besides this, wick ability, colour fastness and dye uptake of fabrics were also measured.

The results showed that cotton fabrics were found to be superior to modal fabrics in terms of crease recovery angle. Bursting strength of treated fabric was found to be greater in comparison to modal fabric.

Moses and Jnanapriya (2016) found that treatment with formic acid (98%) at the concentration of 4% (OWM) for 30 minutes at room temperature, the modal fabric displayed considerable changes in the physical properties.

Wick-ability was found to improve in the modal fabric following treatment with formic acid (98%) at the concentration of 4% (OWM) for 30 minutes at roomtemperature.

They have studied K/S values of fabrics both treated and untreated dyed with annatto, onion, pammogranate, indigo, reactive sulphur dye etc.,. The K/S values were similar for treated and untreated fabrics. The fabrics treated with formic acid exhibited good fastness properties. Lavate (2017) studied the properties of yarn and fabrics produced from modified viscose, tencel, excel and their comparison against cotton. Dirgar (2017) has reported the performance properties of the fabrics produced from Cuproammonium and some other regenerated cellulose fibres.

Experimental Methodology

The **flow chart 1 and 2** presents the methodology adopted in the presentstudy.

Cotton fibre | Modal fibre | Polyester fibre

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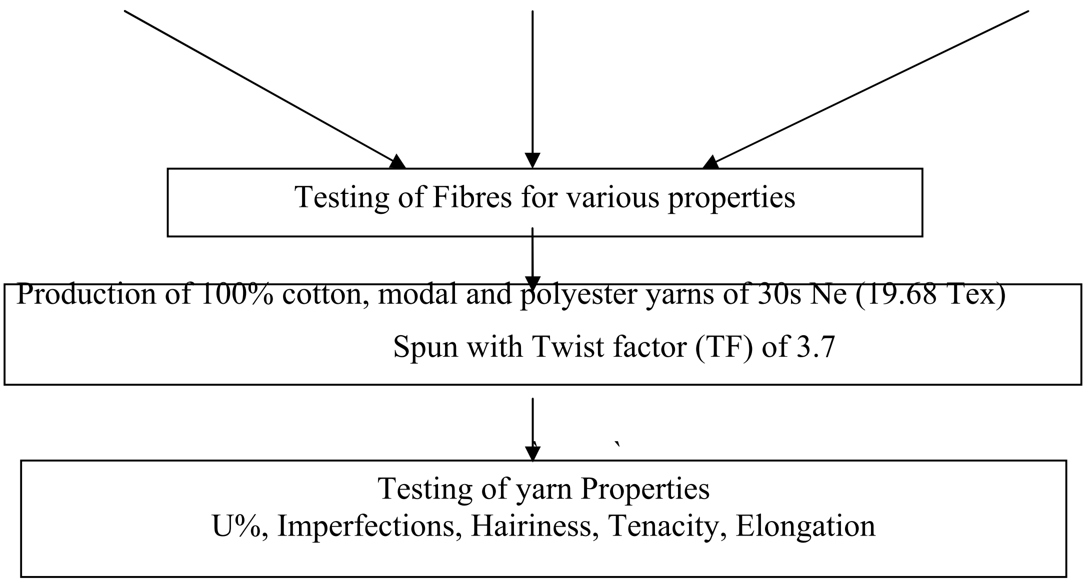
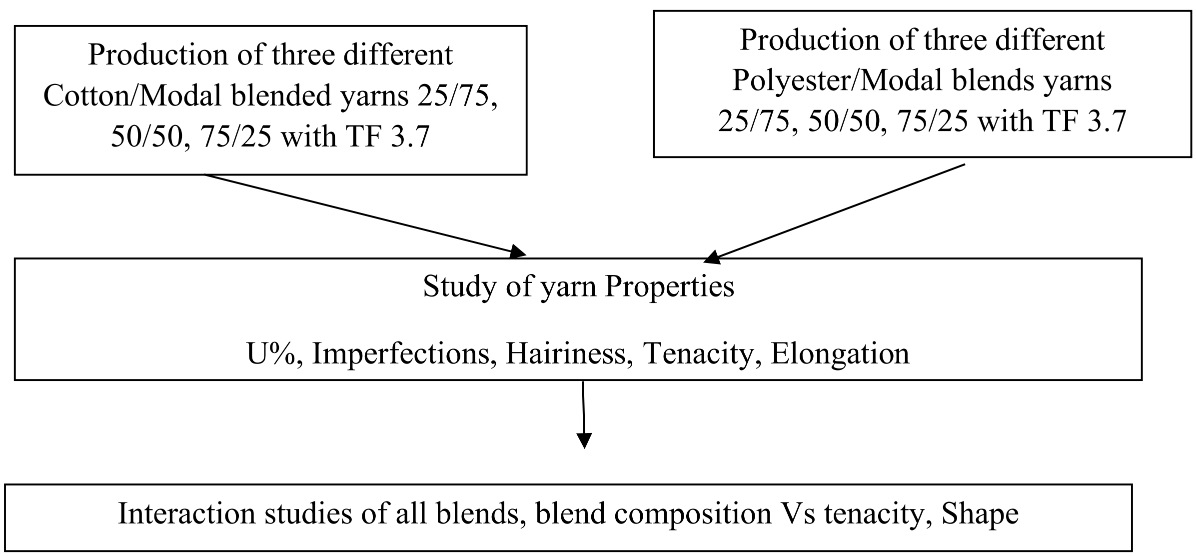


Flow chart – 1: Production of yarn and fabrics from 100% cotton, modal andpolyester fibres



Flow chart-2: Production of yarns and fabrics from cotton/modal and polyester/modal blends

Yarn Production

Trumac blow room line was used for the production of lap and hank of lap produced in all the cases was 0.0014 Ne. Carding machine used was Trumac TC5/1 card and cardsliverof 0.12Ne was produced. Carded sliver was combed (noil-14%) and then drawn using RSB851drawframe. Drawn sliver was further converted to roving using LFS1660 speed frame.

The hank of roving was 1.14 to 1.15. Further the roving was converted to yarn using G5/1 ring frame (spindle speed 16500 rpm)

Results and Discussion

Fibre Properties

Among cotton, modal and polyester fibres polyester was stronger than cotton and modal fibers. Elongation at break was highest for polyester fibre and least for cotton fibres. Fineness (Tex) of all the three fibres was almost same.

Yarn properties

Various properties of 100% cotton, 100% modal, 100% polyester and cotton/modal, polyester/modal blends are presented are presented in **Table 1 and Table 2**.

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Table 1 Yarn Properties of cotton/modal blended yarns

Sl. No	Yarn Variety	Actual count (Ne)	Count (CV), %	CSP	Tenacity, g/tex	Elongation, %	CVm	Thin places	Thick places	Neps	Hairiness Index
1	100% Cotton	29.40	1.88	4326	26.53	6.39	10.68	0	5	13	4.4
2	Cotton/Modal (75:25)	29.94	3.04	3768	22.65	7.01	11.77	0	15	39	4.7
3	Cotton/Modal (50:50)	29.84	1.30	3419	21.47	7.09	10.87	0	5	2.4	4.91
4	Cotton/Modal (25:75)	28.85	1.31	3401	21.54	8.1	10.57	0	5	22	4.93
5	100 % Modal	28.93	2.06	3098	21.05	8.68	10.68	0	7	34	5.4

Table 2 Yarn Properties of polyester/modal blended yarns

Sl. No	Yarn Variety	Actual count (Ne)	Count (CV), %	CSP	Tenacity, g/tex	Elongation, %	CVm	Thin places	Thick places	Neps	Hairiness Index
1	100% Polyester	29.21	1.79	5186	34.83	12.07	10.6	0	1	2	4.21
2	Polyester /Modal (75:25)	24.89	0.74	4462	34.41	12.7	9.4	0	3	13	4.36
3	Polyester /Modal (50:50)	24.13	1.43	3680	29.5	10.82	9.38	0	2	9	4.85
4	Polyester /Modal (25:75)	28.74	1.83	3450	25.33	9.67	10.1	1	4	19	4.89
5	100 % Modal	28.93	2.06	3098	21.05	8.68	11.07	2	8	39	4.99

In regard to polyester/modal blends, it is noticed that, tenacity increases with the addition of polyester fibres. Elongation follows the same trend.

With respect to cotton modal blends, it is found that tenacity of blended yarns is generally lower that of 100% cotton. Elongation of yarns is found increase with increasing in modal content.

Evenness values are better for polyester modal blends. Imperfections are higher for cotton modal blends in comparison of polyester modal blends. Hairiness is less for polyester modal blends in comparison to cotton modal blends. As far as the interactions concerned, a positive value in comparison to cotton/modal blends. There is not much change in the interaction between polyester/modal and cotton modal blended yarns.

As regards thin, thick places negative interactions are noticed while a positive interaction is noticed for cotton/modal blend.

CSP of 100% polyester yarn was highest and 100% modal yarn was lowest. As the percentage of polyester in polyester/modal yarn was increased, the CSP found to get increase. A similar observation was observed when cotton percentage was increased in cotton/modal blend.

It is interesting to note that a negative interaction has occurred in neps for polyester/modal blends while positive interaction is observed in case of cotton/modal blends.

A positive interaction is noticed for hairiness in polyester/modal blends while negative interaction is observed increase of cotton/modal blends. It should be stated in both the cases, the interaction values are small.

Conclusions

1. There is positive interaction between blend composition and tenacity in respect of polyester/modal blend, while a negative interaction is noticed in case cotton/modal blends.

2. As regard to U%, evenness positive interaction is noticed in the case of polyester modal blend, while negative interaction is observed in cotton/modalblends.

3. In case of evenness and imperfections positive interactions are noticed in polymer/modal blends. In case of cotton/modal blend a negative interaction is observed.

4. With respect to hairiness the interaction is very low for polyester/modal blends, positive value is noticed and in case of cotton/modal blends negative interaction is observed.

References

1. BegumA.andSubramaniayamV.,'Compressibilityofplainweftknittedgabrics',Ond. J.

Fibre and Text., Vol. 19, 1994, pp. 185-188.

2. CarnbyG.C.,'Shearpropertiesofweft-knittedfabrics',J.text.Inst.,Vol.65,1974,pp. 87-101.

3. Chamberlain, 'Hosiery yarns and fabrics', City of Leicester College of Technology Leicester, UK, 1949.

4. ChenP.L.,BarkerR.,SmithG.W.andScruggsB.,'Handleofweft-knittedfabrics',Textile Res J., Vol. 62, 1992, pp. 200 – 211.

5. DeJongS.,'Astudyoffabricmechanicsusingenergymethodsofanalysis',Ph.DThesis, University of New South Wales, Australia. 1976.

6. Doyle P.J., 'Some Fundamental aspects of hosiery yarns and their relations to mechanical characteristics of knitted fabrics', J.Text. Inst., Vol. 43, 1952, pp.19-35.

7. ElderHMandSomashekarTH.,'Thedegreeandstabilityofflat-setinweft-knittedcotton fabrics', J.Text. Inst., Vol. 66, pp. 49-54.

8. Popper P., 'Bending of fibre assembles', Sc.D. Thesis, MIT., Cambridge,Massachusetts, 1966.

9. Shanahan W. J and Postle R., 'A theoretical analysis of the tensile properties of plain knitted fabrics, Part I: The load extension curve for fabric extension parallel to the course', J.Text. Inst., Vol. 65, 1974a, pp.200-2012.

10. Shanahan W.J and Postle R., 'A Theoretical analysis of plain knittedfabrics,' TextileRes. J. Vol. 41, 1971, pp. 3/279.