ISSN:2319-6890 (online),2347-5013(print)
1 June 2018

Properties of Polyester, Nylon blended Air-Jet Textured Fabrics

Mrs. Ashwini Raybagi., Prof. Dr. M.Y.Gudiyawar
DKTE Society's Textile and Engineering Institute, Ichalkaranji
Email : ashwiniraibagi@yahoo.co.in

Abstract: Blended Air jet textured yarns were produced using Polyester and Nylon 6 filament yarns as feed materials. The yarns produced were used in the weft way for fabric production using Cimmco auto loom and 65P/35C blended woven yarns were used in the warp. Blends of PET and PA multifilament yarns offer interesting possibilities for producing fabrics with heather effects. The characteristics of the fabrics were tested and it was found that, the drapeability, crease recovery, abrasion resistance and tensile properties are better achievable with Nylon 6 rich fabrics. The Polyester rich fabrics are stiffer, highly abrasive with low tensile characteristics than Nylon wealthy fabrics. Air permeability of fabrics decreases with increase in nylon proportion in the yarn. From the above study, it is concluded that, blending plays a prominent role in altering the properties of the fabrics.

Keywards:- Air jet texturising, Yarn bulk, Blend proportion, Loop instability,

Introduction:

It is well known that among different texturising system, air jet texturing system produces textured yarns aesthetically similar to spun yarn. The added advantage of air jet texturising process is the facility of blending different types of filament yarns together.

The texturising process (1) consists of introducing durable crimps, coils or loops or other fine distortions along the length of filaments or fibres. Texturising of filament yarns is commercially well established. Continuous filaments generally have regular cross sections and smooth surfaces resulting in lower yarn bulk due to close packing. Fabrics made from these yarns lack softness and warmth, but have a shiny appearance and a silk like handle. For certain applications, these characteristics may be desirable, but for most uses, it is essential to texture filament yarns to overcome deficiencies in warmth, appearance and handle.

Commercial texturising processes, with the notable exception of air-jet texturing depend upon the thermoplasticity of the filaments, which are deformed and heat set to produce crimped or coiled, configurations to enhance their bulk. In contrast, air-jet texturing (2) is a mechanical process, suitable for both thermoplastic and non-thermoplastic yarns, in which a bundle of filaments is overfed into a turbulent air steam, where individual filaments are separated and arcs and loops are formed at randomly spaced longitudinal intervals with intermittent, straight portions. Upon emergence from the air-jet, the yarn bundle collapses and the looped filaments become locked in place by interfilament friction. The structure so formed resembles a spun yarn, and is characterized by greater bulk; better covering power, a subdued luster and a warmer hand compared to a continuous filament yarn in its untextured form. Air jet texturing is basically a mechanical process to produce textured yarns without using heat and is, therefore, suitable for texturing thermoplastic and non- thermoplastic yarns.

V.K. Kothari et al (3) in their studies on "Properties of blended air-jet textured yarns" investigated that with the increase in the polyester proportion in the air jet textured blended yarn, physical bulk decreased and the tensile properties such as tenacity, modulus, extension and energy at break increases. They also concluded that, Polyester rich air jet textured blended yarns have lower instability values than viscose rich blended yarns. Blended yarns produced from filament materials have not found the same market acceptance as those from staple fibres because of the unhybridisation of properties of filaments which may manifest itself in non uniform appearance particularly after dyeing, also because of the inherent drawbacks of filament yarn fabrics such as metallic luster, high rigidity, low bulk, unpleasant feel etc. Only through air jet texturising method can these drawbacks and limitations of filament yarns can be overcome, it is thus possible to produce a blended filament yarns with staple yarn feel, bulk, subdued luster, good flexibility and all the good filament yarn properties.

M.Y.Gudiyawar et al (4) in their studies on "Physical properties of PET/PA blended air jet textured yarns revealed that PA rich yarns were found to have lower loop instability, lower physical bulk but higher elongation and skein shrinkage when compared to that of PET rich blends. The tenacity of PET/PA blended air jet textured yarn increases with the increase in the proportion of higher tenacity PA filament yarns was found to be higher as compared to PET rich blended air jet textured yarns.

V. K. Kothari et al (5) conducted studies on "Evaluation of physical bulk of air jet textured yarns" and concluded that, physical bulk of textured yarn varies with process variables, parent material characteristics and depends on winder type and winding tension level during package building. The nature of change in fabric specific volume with the change in process variables depends on a number of factors such as parent material characteristics, relaxation treatment and applied pressure level. The various fabric characteristics which decides the fabric end use as breaking strength, breaking elongation, tearing strength, crease recovery, drape can be altered by changing the structure of textured filament yarn brought by varying the number of filaments.

M. Acar et al (6) in their studies on "Role of water in air jet texturising process" investigated that the wetting of filament improves the effectiveness of the texturising process and results in better quality textured yarns. Only a small amount of water is needed to impart the desired wetting effects. Wetting also reduces the friction between the filaments themselves, which enhances their longitudinal displacements relative to each other, facilitates better loop and entanglement formation and thus generates improved textured yarns.

Water plays an important role in the air–jet texturising process and the effect of water on the structure and properties of single component air-textured yarns has been studied by many research workers.

Experimental Plan:

Material:

Fully drawn Polyester of 116/48 dtex and Nylon 114/48 dtex multi filament yarns were used to produce air textured yarns. In this study, textured yarns were produced at different blend proportions. Five pre-wet samples (S1, S2, S3, S4 and S5) were produced by passing both polyester and nylon components in the water applicator before the air-jet.

Method:

Air- jet textured blended yarns and fabrics were produced using air texturising machine and CIMMCO loom respectively.

Textured yarns were tested for Tenacity, loop configurations, loop instability, physical bulk etc.

Table 2 Characteristics of Air-jet Textured Yarns

	100% Polyester	75P/25N	50P/50N Blended Yarn	25P/75N	100% Nylon
Yarn dtex	253	252	251	250	248
Instability (%)	2.5	2.1	2	1.5	1.2
Physical Bulk (%)	205	180	167	151	154
Loops/cm	143	167	193	201	230
Core dia.(mm)	0.13	0.12	0.12	0.12	0.1
Shrinkage%	4.2	6.1	7.9	9.8	9.9
Tenacity(gms/dtex)	2.8	3.2	3.8	4.1	4.8
Modulus(gms/dtex)	17.5	30.3	16.2	15	18.3
Elongation.%	27	30	34	31	34

Polyester and Nylon 6 air jet textured yarns were used in the weft way for fabric production using Cimmco auto loom and 65P/35C blended yarn in the warp way.

Fabric particulars as follows:-
Machine:-Cimmco auto loom
Loom width: - 64”
Fabric width: - 59”
Warp count-2/30s Ne
Weave-Plain
Loom speed:-130 RPM

Washing of fabric:-

Wet relaxation

Produced grey fabrics have been washed in boiling water at 60^{0}c for 30 min. using 1 g/l detergent and 2 g/l soda ash.

Testing of fabrics:

The characteristics of the fabrics were tested and the effect of blend proportion on the characteristics of fabrics like tensile properties, drapeability, crease recovery, abrasion resistance etc. studied.

- **Tensile Properties:-**

An Instron tester is used to obtain the breaking load elongation curves. Tensile properties of fabrics were measured on Instron tester with ASTM D 2256-95a test method.

- **Drapeability:-**

Drapeability of a fabric is determined using the instrument Drapemeter (IS 8357-1977) and is expressed in terms of Drape co-efficient.

- **Crease recovery angle:-**

Crease recovery is measured in terms of crease recovery angle on crease recovery tester with IS 4681-1968.

- **Tearing strength:-**

The Elmendrof tearing tester is used for tearing test with ASTM D 1424-96.

- **Abrasion resistance:-**

The Martindale abrasion tester, with ASTM D 4966-98**,** is a useful instrument for determining the resistance to abrasion of all clothes.

Results:

Fabric Characteristics

Discussions:

1. Effect on Fabrics Handle:

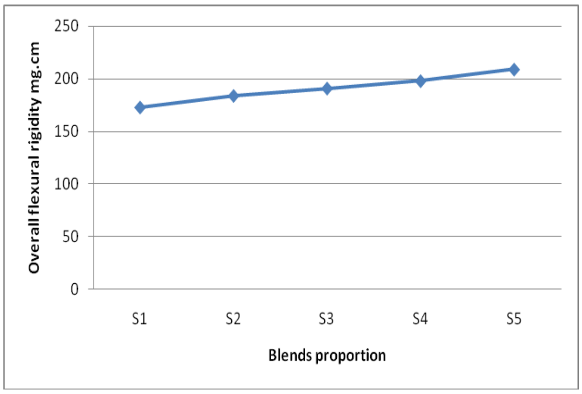

Figure 1.1: Effect of blends proportion on flexural rigidity

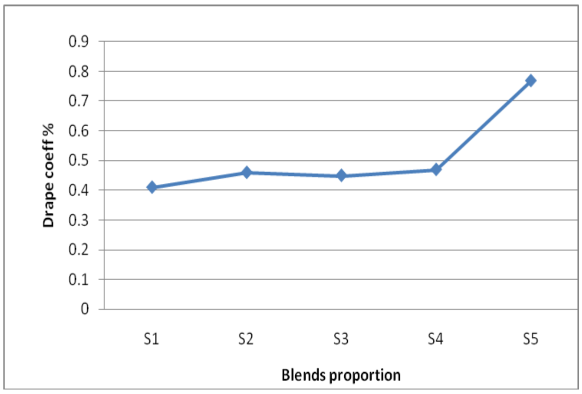

Figure 1.2: Effect of blends proportion on fabrics drape coefficient

As shown in Figure 1.1 and Figure 1.2, the flexural rigidity and drape coefficient of fabrics increases with increase in nylon proportion in the yarn and there is

International Journal of Engineering Research
Volume No.7, Issue No.6, pp : 101-105

ISSN:2319-6890 (online),2347-5013(print)
1 June 2018

significant difference in the flexural rigidity and drape coefficient of different fabrics. Fabric's drape depends on fiber content, type of yarn, fabric structure, and type of finish. In the fabrics investigated in this study, fabric structure and type of finish are same for all the samples. Fiber content and yarn structure are different. Nylon rich yarns have lower bulk and high entanglement structure as compared to polyester rich yarns. The lower bulk of nylon rich yarns results in less openness of yarn structure. The lower openness of yarn structure is responsible for increase in the stiffness. Nylon filament modulus is also higher than polyester. Higher filament modulus leads to higher yarn and fabrics stiffness. These characteristics of nylon rich yarns cause higher fabrics flexural rigidity and drape coefficient. This confirms that the air textured yarn bulkiness has significant influence on the handle of fabrics.

2. Effect on Fabrics crease recovery:

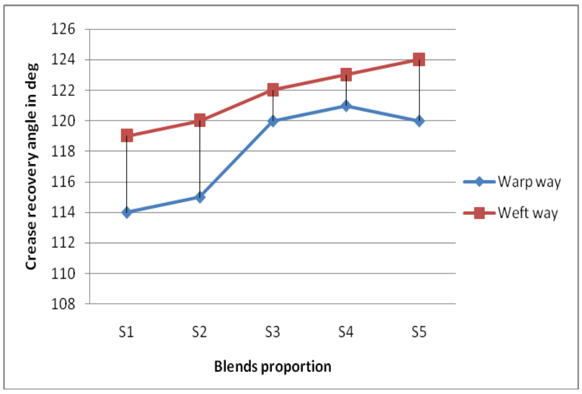

Figure 2.1: Effect of blends proportion on fabrics crease recovery

The crease recovery angle of fabrics increases in weft way with the increase in nylon proportion in the textured yarn as shown in Figure 2.1. There is significant difference in the crease recovery angle of different fabrics in weft way and crease recovery angle is not significant in warp way. Nylon rich fabrics show better crease recovery as compared to polyester rich fabrics. The ability of a fabric to recover from creasing is in the first instance dependent on the type of fibre used in its construction. Elastic recovery of the yarns influences the crease recovery angle and good elastic recovery yarns contribute for higher recovery from creasing at fabric stage. Nylon filament is generally known for its excellent elastic recovery as compared to polyester. Nylon air textured yarns have exhibited better crease recovery in the fabric even with more number of surface loops due to their excellent elastic recovery. This is contradictory to the findings in polyester/viscose textured yarn fabrics. This reveals that the elastic recovery of the feed yarn plays significant role than the air textured yarn structure as far as crease recovery of fabrics is concerned.

3. Effect on Fabrics abrasion resistance:

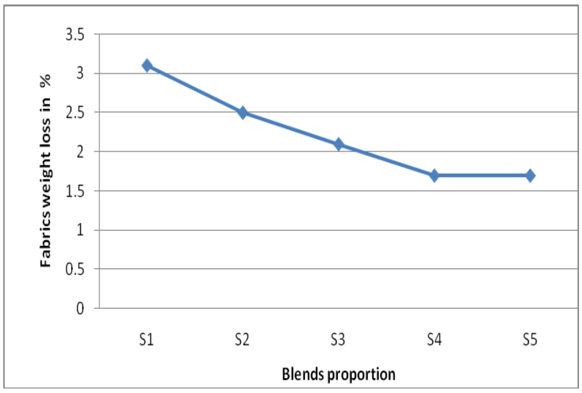

Figure 3.1: Effect of blends proportion on fabrics abrasion resistance

As shown in Figure 3.1, the weight loss of fabrics decreases with increase in nylon proportion in the fabrics. There is also significant difference in the weight loss of different blends proportion fabrics. Nylon rich fabrics have good abrasion resistance as compared to polyester rich fabrics. The good abrasion resistance of nylon rich fabrics is due to higher elongation, higher tenacity and excellent elastic recovery of their feed yarns (Table 2). High elongation, elastic recovery and work of rupture of a fibre are considered to be important factors for a good abrasion resistance of the fabric. This indicates that an air textured yarn with more surface loops can make a fabric with good abrasion resistance provided the feed yarn has good elastic recovery and higher elongation and strength.

4 Effect on fabrics air permeability:

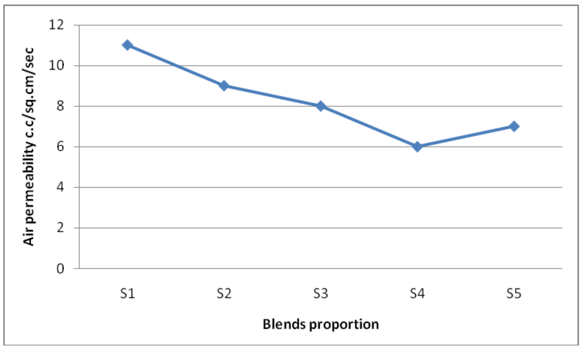

Figure 4. 1: Effect of blends proportion on Air permeability of fabrics

As shown in the Figure 4.1, the air permeability of fabrics decreases with increase in nylon proportion in the yarn. There is significant difference in the air permeability of different fabrics. The decrease in air permeability is due to the decrease in the bulkiness of nylon rich fabrics. There is no significant difference in the cover factors of different fabrics. The fabrics have exhibited different air permeability with almost similar cover factors due to the difference in the weft yarn bulkiness. It reveals that the air permeability of fabrics is also related to yarn bulkiness. Higher the air textured yarn bulkiness, higher is the air permeability of fabrics. More textured yarn bulkiness allows more air to pass through it.

5. Effects on Fabrics Strength:

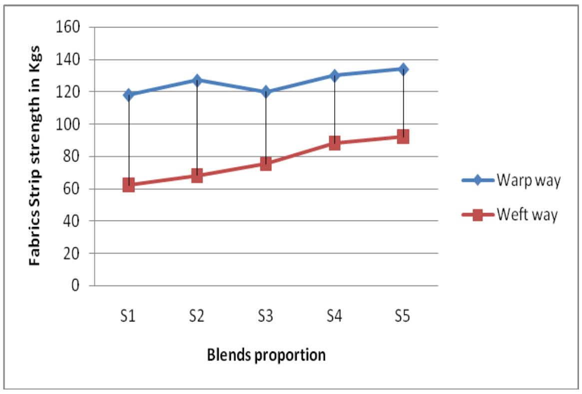

Figure 5.1: Effect of blends proportion on fabrics strength

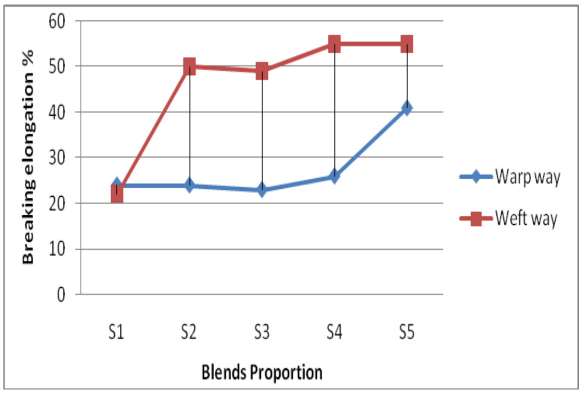

Figure 5.2: Effect of blends proportion on fabrics breaking elongation

The strip strength and breaking elongation of Polyester/nylon blended fabrics is shown in Figure 5.1 and Figure 5.2 respectively. There is significant difference in the breaking strength and elongation of different fabrics in weft way and these characteristics of fabrics have shown increasing trend with increase in nylon proportion in the yarn. However, the breaking strength and elongation are not significant in warp way. The increase in strength and elongation of fabrics in weft way is due to the increase in nylon proportion in the yarns. The nylon rich textured yarns have higher breaking strength and elongation than polyester rich textured yarns (Table 2). The tearing strength of fabrics also follows the same behavior (Table 3).The strength and elongation characteristics of air textured yarns are directly transferred to the fabrics. Therefore, tensile characteristics of fabrics are mainly dependent on the tensile characteristics of the air textured yarns.

The higher tensile characteristics of fabrics in weft way as compared to their warp way fabrics are due to the difference in strength of warp and weft yarns.

Conclusion:-

From the present work, it is apparent that the use of compatible blend components will facilitate the optimization of blended fabric property.

- Crease recovery, abrasion resistance and tensile properties are better achievable with Nylon 6 rich fabrics.
- The polyester rich fabrics are stiffer and highly abrasive with low tensile characteristics than Nylon wealthy fabrics.
- Nylon rich yarns cause higher fabrics flexural rigidity and drape coefficient.
- Air permeability of fabrics decreases with increase in nylon proportion in the yarns.

References:

1. *Kothari V. K., Sengupta A. K., Shrinivasan J. and Goswamy B.C., "Air jet texturing of Cotton filament composite yarns for better apparel comfort", Textile research journal, May 1989, p 292-299.*
2. *M. D. Sankhe, "Air Texturing-Process, product & applications", Man-made textiles in India, Vol. XLIII, No. 1, June 2000.*
3. *Kothari V.K. and Bandyopadhyay S, "Properties of Blended Air-jet Textured Yarns", Textile Asia, Vol. 9, September 2000, p 23-24.*
4. *Gudiyawar M. Y., Kane C. D., Praveen Kumar, "Physical properties of PET/PA blended air jet textured yarns", Chemical fibres international, Vol.4, 2008, p 252-254.*
5. *V. K. Kothari, "Evaluation of physical bulk of air jet textured yarns", Indian Journal of Fibre and Textile Research, Vol. 27, March 2002, P 25-32.*
6. *A. K. Sengupta, V. K. Kothari, and R. S. Rangasamy, "Role of water in air jet texturising process: Part I: Polyester filament feeder yarns with different frictional characteristics", Textile Research Journal, Vol.61, No. 9, 1991, p 495-502.*

Table 3: Polyester/Nylon Blended Air- Textured Yarn Fabric Characteristics

Sr. No.	Fabric Samples/Properties	S1	S2	S3	S4	S5
1	**GSM**	153	157	161	164	163
2	**Cover factor**	21.62	20.79	20.79	20.99	20.9
3	**Warp way Bending Length (cm)**	2.3	2.2	2.3	2.2	2.3
4	**Weft way Bending Length (cm)**	2.7	2.3	2.2	2.2	2.2
5	**Flexural rigidity mg.cm**	173	184	191	192	209
6	**Warp way Crease Recovery Angle**	114	115	120	121	120
7	**Weft way Crease Recovery Angle**	119	120	122	123	124
8	**Abrasion Resistance (weight loss %)**	3.1	2.5	2.1	1.7	1.7
9	**Drape Coeff. (%)**	0.41	0.46	0.45	0.47	0.77
10	**Warp Strip strength (Kgf)**	118	127	120	130	134
11	**Weft Strip strength (Kgf)**	62	68	75	88	92
12	**Warp Breaking Elongation (mm)**	24	24	23	26	41
13	**Weft Breaking Elongation (mm)**	22	50	49	55	55
14	**Tearing Strength (gf)**	3654	4211	5241	5440	5984
15	**Air Permeability (c.c/sq. cm / sec)**	11	9	8	7	6