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Identifying the strength properties of cotton polyester blended woven fabrics of different fiber content

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Abstract

Strength has direct consequences with the polyester content percentage of the cotton polyester blended woven fabrics. The findings of this research proved that strength is increased if the polyester content percentage is increased in the cotton polyester blended woven fabrics and vice versa. Three types of cotton polyester blended woven fabrics of different composition and constructions were used in this research and for doing the required tear and tensile tests. Finished fabrics were collected from the fabric mill for conducting the required strength tests in accordance with ASTM D2261 standard (tear) and ASTM D76 standard (tensile). This research proved that strength depends on the polyester content percentage of cotton polyester blended woven fabrics and it opened a potential way for the scholars to further study in this field.

Keywords: Fiber blend, strength, composition, woven fabrics, absorbency, breathability, durability.

Introduction

Abdel Halim et al reported that natural fibers are less uniform than manmade fibers and they are easily affected by other harmful materials.

Cotton is a natural fiber that can show its strength when washed, but synthetic fibers like polyester are naturally stronger than cotton in normal stage due to its shape and internal structure that is made up with refined terephthalic acid or its dimethyl ester dimethyl terephthalate and monoethylene glycol[1].

Chen et al reported that cotton is swelled in water, it can absorb moisture and it can grow mildew and this fiber can be weakened slowly. But polyester fibers do not swell in water and do not absorb moisture so it has very less chance to be damaged caused by mildew, fungus, yeast or other insects[2].

Hou et al reported that blended polyester fabrics or 100% polyester fabrics expose more strength in compare to 100% cotton fabrics. Even, cotton polyester blended with other natural fabrics shows more strength than 100% cotton fabrics[3].

Carosio et al reported that cotton polyester blended fabrics show more pilling resistant property and abrasion resistant property compared to 100% cotton fabrics[4].

Atakan et al reported that cotton is breathable, absorbent, it can wick sweat, it can transfer moisture between fabric and body so it feels cool, relaxed and comfortable[5].

Liu et al also reported that cotton is made up of cellulose which is sustainable and biodegradable. These fibers do not show any harmful characteristics towards nature, it's strength is moderate to above average. But manmade polyester fibers are stronger than cotton fibers[6].

Islam et al reported that temperature application on cotton spandex woven fabrics can improve the elasticity, stretch and growth[7].

Islam et al proved that optimum strength of cotton spandex woven fabrics can be achieved by proper heat setting process[8].

Islam et al experimented that heat setting can improve the abhorrent level of fabric shrinkage of cotton spandex woven fabrics[9].

Zhang et al reported that cotton fibers can show very good performance in textile wet processing zone because of its good absorbency and moisture content properties[10].

Nourbakhsh et al proved that cotton fibers are swelled in water, absorb water and shrink in water. But polyester fibers do not swell in water and they do not shrink, so they do not have any affinity towards shrinkage[11].

Novak et al reported that polyester fibers are made up of manmade substances and petroleum that's why they are not sustainable and biodegradable[12].

Islam et al also experimented that cotton and polyester blend together can make such a types of cloth that only cotton or only polyester cannot make alone. Shrinkage properties of cotton polyester spandex depend on the composition of its blend. Higher the polyester content in the blend, lower the shrinkage values are[13].

Soares et al experimented that burning of cotton will create white or grey smoke and smells like paper burning, but burning of polyester create black smoke that is harmful to nature[14].

Liu et al also experimented that cotton shrink in water but polyester shrink while melting or burning[15].

Jiang et al experimented that polyester has a propensity to stick to the body when sweating started, it is tear resistant, and it is not abrasion resistant like cotton. In hot climate, 100% cotton fabric is best suited but in cold climate, cotton polyester blended fabrics are more suited[16].

Carrera et al also reported that cotton polyester blend can be best choice because of getting a mixture of characteristics of wearer satisfaction, user's comfort and moisture absorbing property etc. polyester is added in the blend to reduce shrinkage property[17].

Jhanji et al reported that 100% polyester fabrics are crunchy and they have rough surface. They are hydrophobic in nature and they absorb no water or moisture. Therefore, they do not allow perspiration to pass out. As a result, they are not comfortable to wear[18].

Sadaf et al also reported that cotton has property like absorbency and breathability. On the other hand, polyester has property like strength and durability. Therefore, by blending both these two fibers of cotton and polyester, properties like strength, durability and absorbency can be achieved[19].

Materials and methods

Materials: Cotton polyester woven fabrics are the major raw materials for this study. Cotton polyester blends were used in this research and to do the required tests. Different types of cotton polyester blended woven fabrics with different composition, construction, weaves and weight g/m2) were used in this research as shown in Table-1. For doing strength tests, finished raw woven fabrics were collected from fabric mills just after finishing is done and tests were conducted out.

In Table-1, at serial no A, the given construction is 7×6/ 82×66 that shows a construction of a cotton-polyester blended woven fabric, where the percentage of cotton-polyester bending is 85% cotton and 15% polyester. In this construction, warp yarn count is 7 and weft yarn count is 6, which are made up of cotton-polyester blends. Thread density in ends per inch is 82 and picks per inch is 66. Two other constructions in serial no B and C demonstrate the similar physiognomies with different composition.

Strength measuring method: Strength tests like tear and tensile were carried out in agreement with ASTM D2261[20] standard and ASTM D76 standard[21].

Tear testing equipment: Tear strength was conducted with "Instron 5900 tear testing machine" in accordance with ASTM D2261 Standard. For reaching to the required moisture equilibrium, fabric was conditioned in accordance with ASTM D2261 Standard. Depending on the nature of the specimen, the tearing force were shown as a peak or a series of peaks. The highest peaks appeared to reflect the strength of the specimen to tear. Figure-1 shows a tear testing machine[22].

Tensile testing equipment: "TESTEX tensile testing machine TF001" was used to measure the tensile strength of the fabric in accordance with the ASTM D76 standard. Two sides of the specimen were clamped into the upper jaw and lower jaw. Foot pedals were used to open and close the jaws. The machine has a huge assortment of specimen grips and fixtures available that allows the wide range of test methods. This machine is equipped with a high quality load-cell system that can ensure the maximum accuracy to the limit. Figure-2 shows a tensile testing machine[23].

Table-1: Cotton polyester woven fabrics of different types.

Composition	Construction	Weave	Width (inches)	weight (g/m^2)
85% Cotton and 15% Polyester	7×6/ 82×66	3/1 Right Handed Twill	57	295
75% Cotton and 25% Polyester	7×6/ 82×66	3/1 Right Handed Twill	57	295
65% Cotton and 35% Polyester	7×6/ 82×66	3/1 Right Handed Twill	57	295

Figure-1: Instron 5900 tear testing machine.

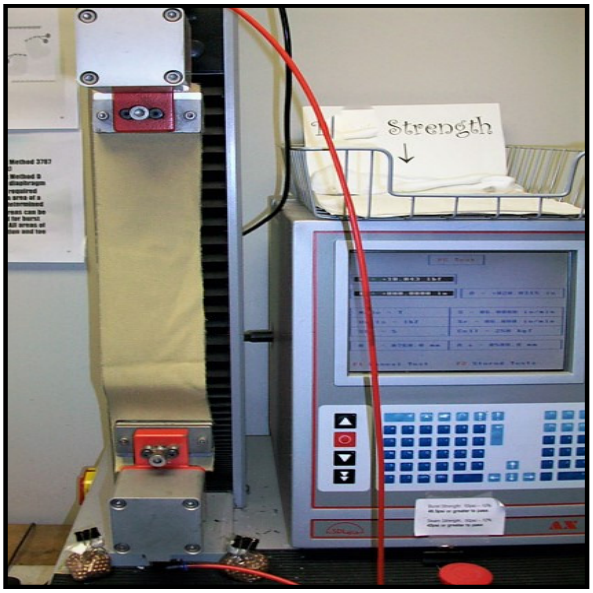

Figure-2: TESTEX tensile testing machine TF001.

Experiment of tear strength: To accomplish this experiment and the required strength tests three different types of cotton polyester woven fabrics were used as mentioned in the Table-1. Sample of size "3-inch x 8-inch" rectangular size was cut from the original fabric and were placed into the "Instron 5900 Tear Testing Machine" to measure the tear strength of the fabric in ASTM D2261 Standard. Figure-3 shows the prepared sample for tear strength of fabrics. One side of the cut end was clamped into the upper jaw and the other was clamped into the lower jaw. The jaws moved apart at a constant rate until the fabric began to tear. Foot pedals were used to open and to close the jaws. Fabric should be conditioned according to ASTM D2261 standard to reach to the required moisture equilibrium in the atmosphere before testing. Experiments were conducted in the specified standard and found the consequences shown in Figure-5.

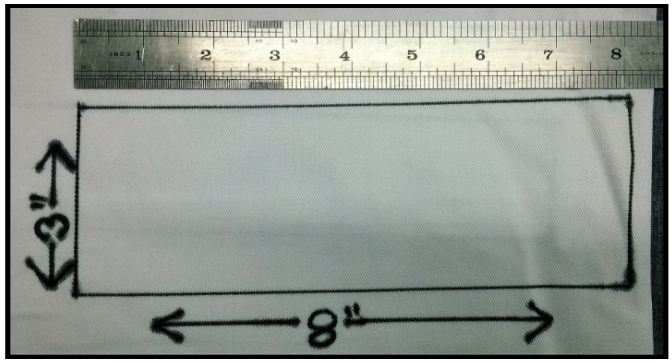

Figure-3: Sample preparation for tear strength.

Experiment of tensile strength: For conducting this experiment and the required strength tests three different types of cotton polyester woven fabrics were used as mentioned in the Table-1. Sample of size "2.5-inch x 8-inch" rectangular size was cut from the original fabric and were placed in the "TESTEX Tensile Testing Machine TF001" to measure the tensile strength of the samples in accordance with the ASTM D76 Standard. Figure-4 shows the prepared sample for tensile strength of fabrics. For the smooth control of the machine a computer controlled system is adjusted with it. This equipment is computer-connected to a data analyzing system software to process and to display the results in the required standard. Two sides of the specimen were clamped into the upper jaw and lower jaw. Foot pedals were used to open and close the jaws. Experiments were conducted in the specified standard and found the consequences shown in Figure-6.

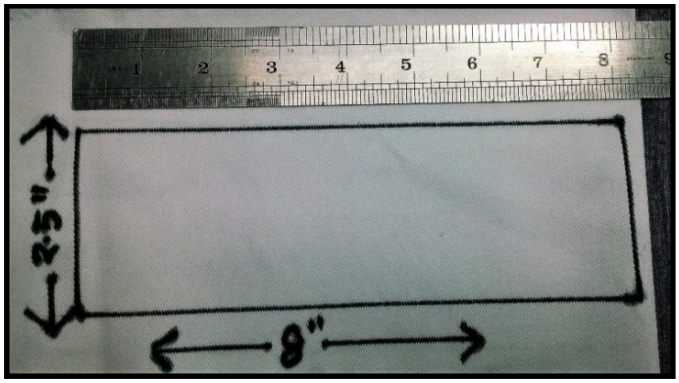

Figure-4: Sample preparation for tensile strength.

Results and discussion

Increased percentage of polyester content in the cotton polyester blends exposed the values of higher strength results both for tear and tensile. Trials were carried out using three different nomenclature mentioned in Table-1 against different composition and showed the consequences in Figure-5 and Figure-6.

Result of tear strength: It is seen from the Figure-5 that, for 85% cotton and 15% polyester, warp tear strength is found 5.978 kg and weft tear strength is found for 4.133 Kg. For the fabric of 75% cotton and 25% polyester warp tear strength is found 7.492 kg and weft tear strength is found for 5.312 Kg. And for the fabric of 65% cotton and 35% polyester warp tear strength is found 9.862 kg and weft tear strength is found for 6.588 Kg. It is seen that, tear strength is increased with the increase of polyester content percentage in the cotton polyester blend of fabrics.

Result of tensile strength: It is seen from Figure-6, for 85% cotton and 15% polyester, warp tensile strength is found 76.21 kg and weft tensile strength is found for 41.56 Kg. For the fabric of 75% cotton and 25% polyester, warp tensile strength is found 88.46 kg and weft tensile strength is found for 53.42 Kg. And for the fabric of 65% cotton and 35% polyester warp tensile strength is found 99.34 kg and weft tensile strength is found for 66.11 Kg. It is seen that, tensile strength is increased with the increase of polyester content percentage in the cotton polyester blend of fabrics.

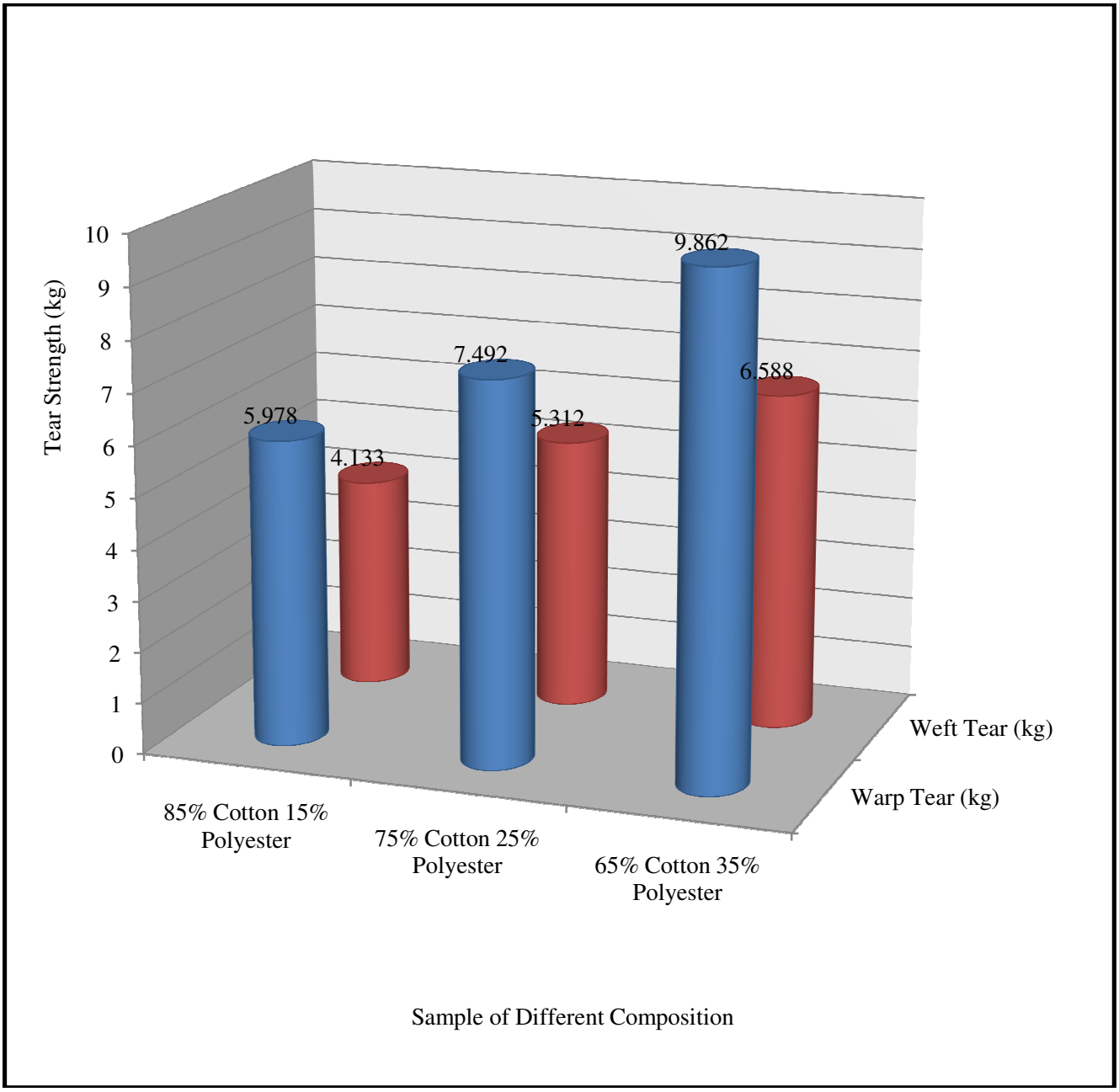

Figure-5: Tear strength of different composition.

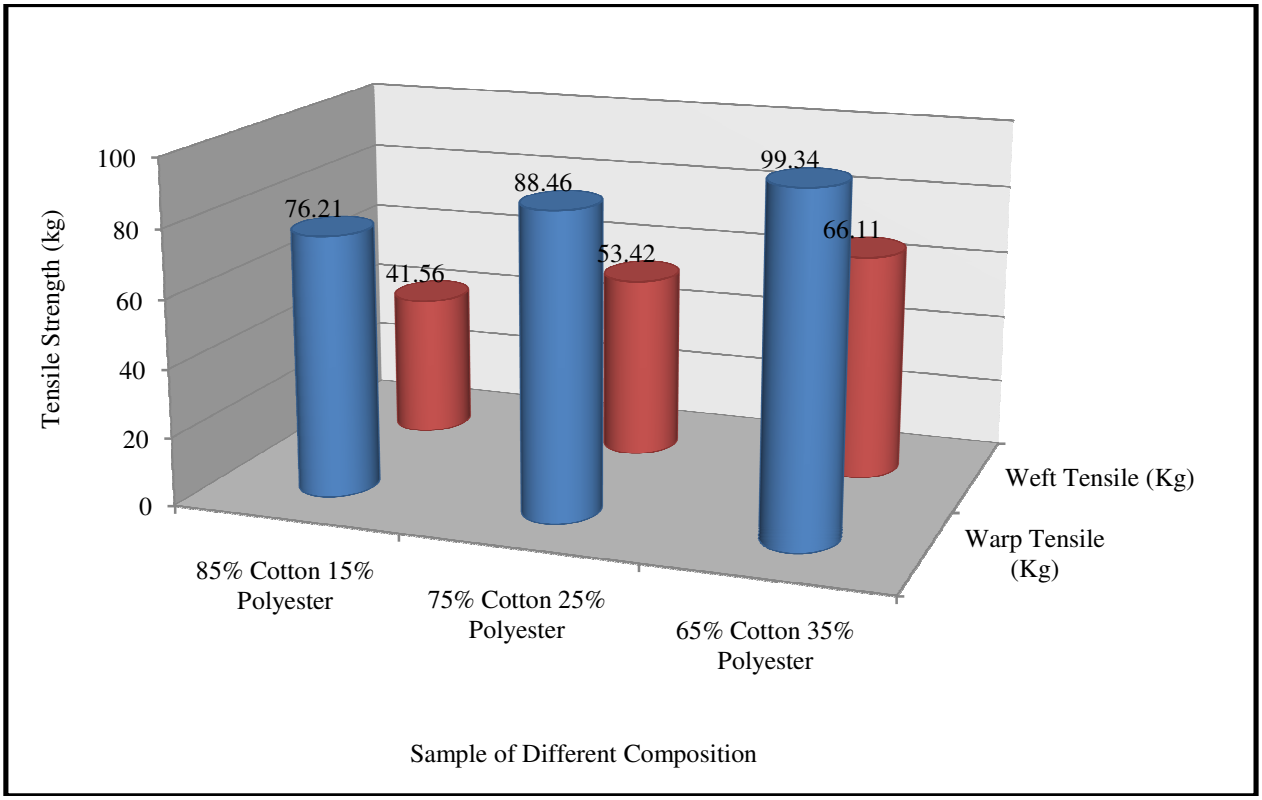

Figure-6: Tensile strength of different composition.

Conclusion

It is seen throughoutthe research that increased percentage of polyester content in the cotton polyester blend, results in higher strength. The more the polyester content percentage in the blend is, the better the strength is. Blending of cotton polyester fibers are like blending the individual characteristics of each fiber to attain some uniform features in the blended fabric. Natural cotton is breathable, absorbant and can content moisture that provides comfort, warmth and good feel. On the other hand, manmade polyester is resistant to water due to its chemical composition that provides strength, durability and wrinkle resistant property etc. Blending of cotton polyester fibers contribute to bring together the properties like strength, breathability, absorbency, comfort, durability etc. The more the cotton fibers are in the blend, the better the breathability and absorbency are in the fabrics. Conversely the more the polyester content in the blend is, the better the strength is, which is experimented in this research.

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