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Predicting Bursting Strength Behavior of Weft Knitted Fabrics Using Various Percentages of Cotton, Polyester, and Spandex Fibers

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Abstract

The bursting strength is an essential quality parameter of knit fabric. The fabric structure, weight, types of fibers, and fiber blend proportion influence the bursting strength parameter. The tenacity of polyester fiber is better than cotton and spandex. The study focused on predicting knit fabric bursting strength test value using different fibers (cotton, polyester, and spandex) with varying percentages of the blend ratio. This study used fifteen categories of blended fabrics. The Pearson Correlation and the hypothetical ANOVA regression analysis were conducted to do the statistical significance test. The experimental result reveals that the bursting strength test result increased with the increased percentage of polyester and suggested a suitable regression equation. The dominance of the polyester fiber was observed throughout the experiment, *i.e.*, the higher the polyester blend proportion, the higher the bursting strength value. The inclusion of polyester in blends can reduce the cost of fabric. The developed prediction model or equation can help the fabric manufacturer make appropriate decisions regarding getting the expected bursting strength. The researcher hopes that the findings from this study will motivate new researchers, advanced researchers, and the textile manufacturing industry.

Keywords

Kilopascal, Prediction, Bursting-Strength, Blended Fabric, Cotton, Polyester, Spandex

1. Introduction

1.1. Background of the Research

The study focused on seeing the effect of the bursting behavior of blended weft knitted fabric by using cotton, polyester, and spandex with varying percentages of blend ratio of cotton, polyester, and spandex. There are several reasons behind the selection of the topics. The requirement of bursting strength of sportswear or functional wear is high. The sportswear garment is manufactured from CVC (Chief Value Cotton) fabric. A certain percentage of spandex is incorporated with cotton. The price of both cotton and spandex is high. The cost of spandex is much higher than cotton. In the blends, the third fiber polyester appeared in this study. Polyester is a man-made fiber with high tenacity and elongation that tends to provide higher bursting strength value. Moreover, the regression equation comes into the picture to predict the required bursting strength of knit fabrics before manufacturing CVC fabrics.

1.2. Research Done in This Field

The literature survey found that many researchers studied bursting behavior on weft-knitted fabrics to better enrich related research topics. A study investigated the effect of increasing spandex ratio, loop length, stitch density, fabric structure (lock knit, interlock), and fabric weight on bursting strength using cotton/spandex and nylon/spandex. It was found from their Research that the spandex fiber blend ratio influences the bursting strength [1]. Another study was done on banana/cotton blends to see the effect of blend ratio on bursting strength, abrasion resistance, and pilling resistance. That study revealed that the bursting strength increased with the percentage of bananas, and increasing the banana fiber blend ratio increased bursting strength [2]. Another study investigated the effect of knit structure and mechanical properties by using 80% lambswool and 20% polyamide with the washed sample. The knit structure influenced bursting strength and other related properties [3]. Research on bursting strength using virgin polyester with recycled polyester revealed no significant differences in bursting strength compared to 100% polyester [4]. The loop length and raw material raw material affect bursting strength [5].

1.3. Missing in Previously Done Research

Previous researchers used blended materials with two fibers: cotton/spandex and nylon/spandex, wool/polyamide. The literature survey did not find the Research concerning more than two fibers in the blend.

1.4. Author's Explanation of Those Not Addressed in Previously Done Research

This study was conducted with natural and manufactured fibers with varying percentages of cotton, polyester, and spandex fibers. Earlier Research concentrated on comparative study rather than predicting dependent variables (bursting strength). The study involved predicting a suitable regression equation or model for the bursting strength test value.

1.5. Originality of the Research

This study is a new and original research work. The study findings are helpful to the fabric manufacturers and buyers who decide the percentage of fiber blend proportion in terms of the bursting behavior of knit fabrics.

1.6. What Is Bursting Strength?

The bursting strength of a knit fabric is the pressure force required to rupture the fabric. The measurement unit of the bursting strength test is kPa (kilopascal). Kilopascal is a unit of pressure. The other units, like Psi (pound per square inch), kN/m^2, and N/cm^2, are also used. The conversion factor can transform the kPa into Psi. The Psi = kPa × 0.145038. Once the bursting machine operates, the diaphragm moves upward through hydraulic or pneumatic pressure. This pressure is required to inflate the specimen, known as tare pressure recorded in kPa. After inflation, the specimen starts to burst. The difference between the total pressure needed to break the sample and the pressure to inflate the expandable diaphragm is known as bursting strength. This tare pressure is to be deducted from the final reading (kPa) to get the actual bursting strength test value. The development and application of blended fabrics are the present focus of R&D efforts globally. The title of this publication corresponds to the current worldwide demand.

Cotton is the best natural fiber. The polyester links several monomers (esters) within the fiber. Polyester is a fiber with high tenacity (g/tex) and elongation%, which can help to increase fabric strength. Spandex is a non-biodegradable fiber typically used in sportswear and comfort wear. The spandex can stretch up to 500% or even more than 500%. DuPont's laboratory first invented spandex in 1959 in Virginia. Spandex takes 20 - 200 years to break down but not degrade. After a few years, spandex may break into microplastics.

1.7. Factors Responsible for Bursting Strength

1.7.1. Fiber Stage

Fiber parameters influence the bursting strength; the higher the staple length, the higher the bursting strength test value (kPa). The higher the staple length, the higher the bursting strength test value (kPa). The higher the micronaire (fineness) and length, the higher the bursting strength test value (kPa). The higher the fiber strength (g/tex), the higher the bursting strength test value (kPa). The higher the uniformity ratio, the higher the bursting strength test value (kPa). The higher the fiber elongation, the higher the bursting strength test value (kPa). The higher the fiber maturity index, the higher the bursting strength test value (kPa). The type of fibers influences bursting strength. The bursting strength of polyester fiber is higher than that of cotton.

1.7.2. Yarn Stage

The type of fibers used in yarn influences bursting strength. The yarn made from polyester fiber is higher than cotton. The higher the yarn C.S.P. (count strength product), the higher the bursting strength. The higher the single yarn strength (cN/tex), the higher the bursting strength. The higher the imperfections in the yarn, the lower the bursting strength. The higher the T.P.I. (Twist per inch), the higher the bursting strength. The lower the u%, the higher the bursting strength. The yarn made with double-ply or triple-ply gives a higher bursting strength [6]. The fiber types and blend proportions percentage in blends influence bursting strength. The linear density of yarn or yarn count also influences bursting strength. The higher the yarn count, the higher the bursting strength.

1.7.3. Fabric Stage

The fabric parameters influence bursting strength such as fabric count, stitch density, fabric GSM, fabric structure, fabric composition, fabric cover factor, fabric tightness factor, fabric shape factor, fabric porosity, fabric thickness, stitch length, shrinkage% [7]. The air permeability of fabric influences bursting strength. A fabric with higher air permeability tends to lower bursting strength value.

1.7.4. Dyeing Stage

The fabric dyeing parameters influence bursting strength, such as the variation of pH value in the dye bath, dosing of dispersing agent, amount of sodium chloride and soda (NaOH), types of soda and salt, dyeing process, dyeing shade% [8].

1.7.5. Finishing Stage

The fabric finishing parameters influence bursting strength such as heat-setting, fabric compacting process, application of softener in finishing process, the application of different finishes like wrinkle-free finish, paper touch finish, silky soft finishes, water repellent finish, polyethylene finish, silicon finish, international finish [9].

1.7.6. Testing Stage

The fabric test parameters influence bursting strength, and this is categorized into three groups:

Man: Skillness, knowledge of test procedure, ability to analyze results.

Machine: Time to burst/rupture, bursting speed of Bursting strength tester. Calibration status of bursting strength tester.

Material: Regular use of control fabric, maintaining repeatability test, retest, duplicate test, or related in-house quality control activities [10].

2. Materials & Methods

2.1. Materials

2.1.1. Blended Fabrics

The study used single jersey weft blended knitted fabrics with three different fibers: cotton, polyester, and spandex, with varying percentages of blend ratios. The yarn count and fabric weight were 34/1 ring-spun and 190 GSM (Gram per square meter). **Table 1** shows the names of fifteen blended fabrics used and those categorized into groups: Group 1, Group 2, and Group 3.

Table 1. Fifteen types of blended knit fabrics.

Group	Fabric Composition
Group 1	Cotton 90%, Polyester 5%, Spandex, 5%
	Cotton 90%, Polyester 6%, Spandex, 4%
	Cotton 90%, Polyester 7%, Spandex, 3%
	Cotton 90%, Polyester 8%, Spandex, 2%
	Cotton 90%, Polyester 9%, Spandex, 1%
Group 2	Cotton 85%, Polyester 10%, Spandex, 5%
	Cotton 85%, Polyester 11%, Spandex, 4%
	Cotton 85%, Polyester 12%, Spandex, 3%
	Cotton 85%, Polyester 13%, Spandex, 2%
	Cotton 85%, Polyester 14%, Spandex, 1%
Group 3	Cotton 80%, Polyester 15%, Spandex, 5%
	Cotton 80%, Polyester 16%, Spandex, 4%
	Cotton 80%, Polyester 17%, Spandex, 3%
	Cotton 80%, Polyester 18%, Spandex, 2%
	Cotton 80%, Polyester 19%, Spandex, 1%

2.1.2. Preparatory Process Involved in the Study

The yarn had been produced from BCI (Better Cotton Initiative) U.S. Upland cotton, staple polyester, and spandex. USTER HVI 100 ensures raw cotton parameters like maturity index, uniformity ratio index, spinning consistency index S.C.I. (138), strength, elongation%, Rd (71.0), +b (9.8), upland grading (42-1), short fiber content S.F.C. (243), trash grade (4). The state-of-the-art spinning machine used for manufacturing quality yarn. The count of the yarn was 34/1Ne ring-spun. The latest model knitting machine (Terrot, Germany) knitted the grey fabrics. The fundamental knitting parameters were 32-inch diameter, 24 machine gauge, stitch length of 29.0 mm, yarn linear density (34/1Ne), grey GSM (190), and finished GSM (180). The excellent brand dyes from BEZEMA, Germany, and disperse dyes from Taiwan, and suitable brand auxiliaries treated the fabrics as usual. Two dye-stuff types (reactive and dispersed dyes) dyed the blended fabrics. The Stenter (Monfortis, Germany) and Compactor (Lafer, Italy) machines finished the study samples.

2.2. Method

2.2.1. Test Standard

The international test standard ISO 13938-2:2019-Textiles, Bursting properties of fabrics Part 2: Pneumatic method for determination of bursting strength and distension [11].

2.2.2. Test Equipment & Apparatus

The bursting strength test used the Digital Bursting Strength Tester TRUBURST

(James Heal, UK). Figure 1 shows a Digital Bursting Strength Tester used for this study.

2.2.3. Test Procedure

The materials (fabric samples) are cut from the fabric roll 150 mm from the fabric's selvage, as shown in Figure 2.

The bursting strength test followed the test standard (ISO 13938-2:2019). The sample was initially maintained in an atmosphere that met international standards for atmospheric conditioning environment (RH: 65% ± 4%, temperature: 20˚C ± 2˚C) (ISO 139:2005) [12]. After conditioning, the test was conducted with a dome size (specimen test area) of 7.3 cm^2. The unit of measurement for the bursting strength test result is kPa. Figure 3 shows the main testing stages of bursting strength.

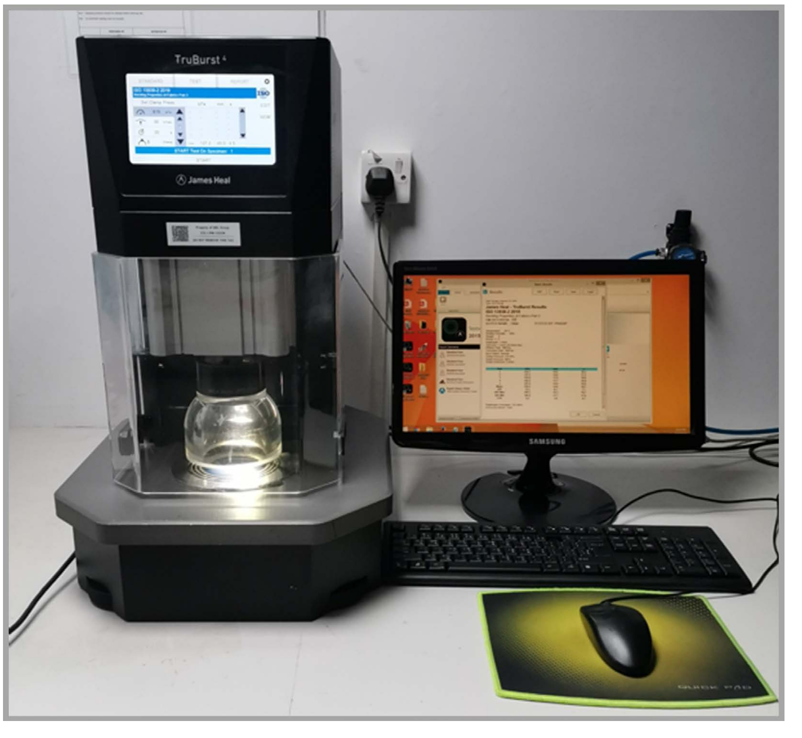


Figure 1. The digital bursting strength tester.

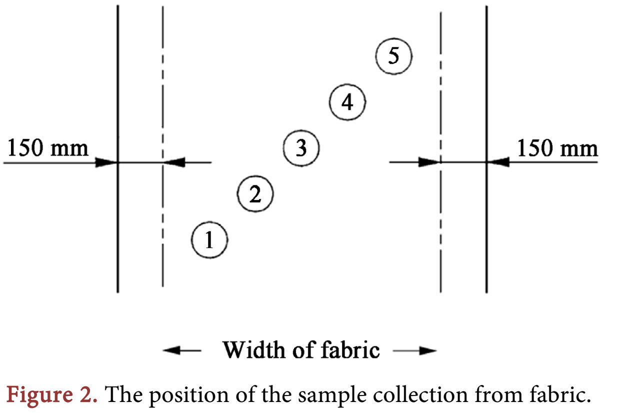


Figure 2. The position of the sample collection from fabric.

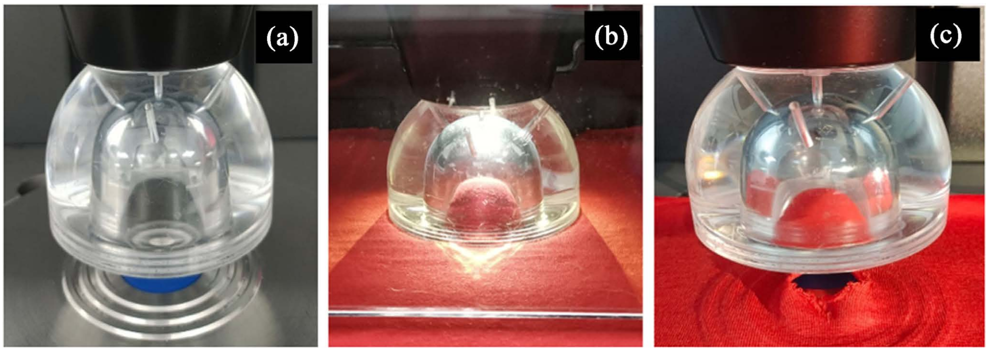


Figure 3. (a) the testing zone, (b) the test in action, and (c) the test done.

2.2.4. Calculation of the Test Result

The following formula calculated the bursting strength:

$$\text{Bursting Strength} = P1 - P2$$

where,

P1 is the pressure required to rupture the specimen.

P2 is the pressure required to inflate the diaphragm.

The unit of bursting strength is kPa (Kilopascal).

The equipment used for this experiment was digital and automatic. The manual calculation was not required.

3. Result and Discussion

3.1. Group 1 Fabrics Data Analysis

Table 2 and Figure 4 represent the bursting strength average data for fabrics in

Table 2. Bursting strength test results (kPa) of Group 1 Fabrics.

Group	Fabric Composition				
	C90P5E5	C90P6E4	C90P7E3	C90P8E2	C90P9E1
Group 1	253.0	253.6	257.1	257.1	257.2

Note: C stands for cotton, P stands for polyester, and E stands for spandex fiber.

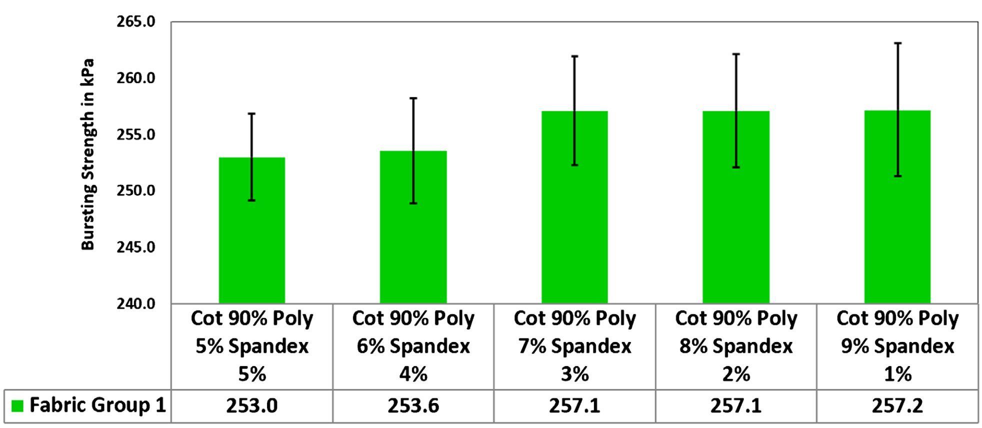


Figure 4. A graphical display of the bursting strength of Group 1 Fabrics.

Group 1, and these are C90%P5%E5%, C90%P6%E4%, C90%P7%E3%, C90%P8%E2%, and C90%P9%E1%. The x-axis indicates the types of blended fabrics, and the y-axis shows the bursting strength in kPa. The upward trend of the graphical data indicated that the bursting strength (kPa) increased as the percentage of polyester fiber blend gradually increased. The fabric with C90%P5%E5% shows the lowest bursting value, and the fabric with C90%P9%E1% shows the highest.

3.2. Group 2 Fabric Data Analysis

Table 3 and Figure 5 represent the bursting strength average data for fabrics in Group 2, and these are C85%P10%E5%, C85%P11%E4%, C85%P12%E3%, C85%P13%E2%, and C85%P14%E1%. The fabric with C85%P10%E5% shows the lowest bursting value, and the fabric with C85%P14%E1% shows the highest.

Table 3. Bursting strength test results (kPa) of Group 2 Fabrics.

Group	Fabric Composition				
	C85P10E5	C90P11E4	C85P12E3	C85P13E2	C85P14E1
Group 2	261.2	261.9	266.4	270.9	272.0

Note: C stands for cotton, P stands for polyester, and E stands for spandex fiber.

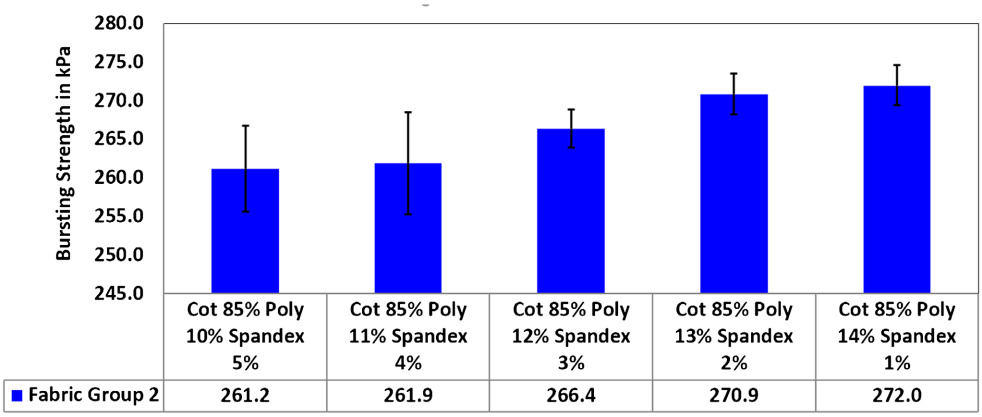


Figure 5. A graphical display of the bursting strength of Group 2 Fabrics.

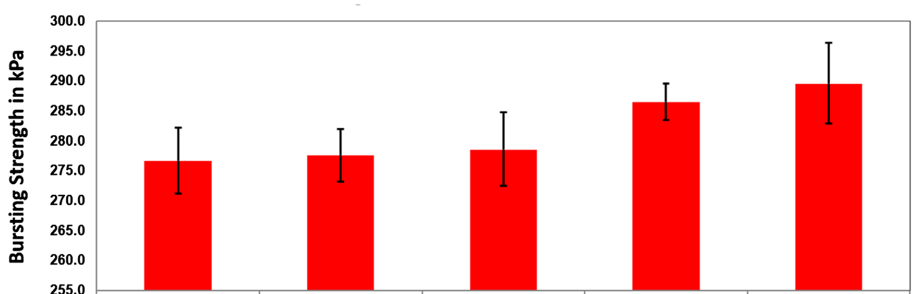
3.3. Group 3 Fabric Data Analysis

Table 4 and Figure 6 show the average bursting strength data for fabric with group 3, which is C80%P15%E5%, C80%P16%E4%, C80%P17%E3%, C80%P18%E2%, and C80%P19%E1%. The fabric with C80%P15%E5% shows the lowest bursting value, and the fabric with C80%P19%E1% shows the highest.

Table 4. Bursting strength test results (kPa) of Group 3 Fabrics.

Group	Fabric Composition				
	C80P15E5	C80P16E4	C80P17E3	C85P18E2	C85P19E1
Group 3	276.7	277.6	278.6	286.5	289.6

Note: C stands for cotton, P stands for polyester, and E stands for spandex fiber.



	Cot 85% Poly 10% Spandex 5%	Cot 85% Poly 11% Spandex 4%	Cot 85% Poly 12% Spandex 3%	Cot 85% Poly 13% Spandex 2%	Cot 85% Poly 14% Spandex 1%
Fabric Group 3	276.7	277.6	278.6	286.5	289.6

Figure 6. A graphical display of the bursting strength of Group 3 Fabrics.

3.4. Effect of Cotton Blend Ratio on Bursting Strength

The strength (gm/tex), fiber length, and elongation properties of cotton fiber play a vital role in achieving the required bursting strength value. American upland and BCI cotton with 31.8 g/tex (tenacity), 28.8 mm length, and 7.0% elongation was employed in this study. Count, stitch length, and tightness factor affect knit fabric bursting strength inversely [13]. Cotton needs to go through opening, cleaning, carding, and combing; consequently, the degree of crystallinity decreases, reducing its bursting strength. The cross-linking agent can reduce bursting strength as this agent resists the mobility of fibers in the fabric structure [14]. When the cotton is associated with blending, the strength and elongation of other fibers interfere and provide combined output.

The chemical structure of the cotton cellulose is also responsible for the variation in test results [15]. Each glucose unit of cellulose is attached to the next by a covalent bond, the C-O-C linkage, flanked by two hydrogen bonds. These bonds are comparatively weaker and tend to break while stretching for a bursting test operation. Figure 7 shows the chemical structure of cellulose [16].

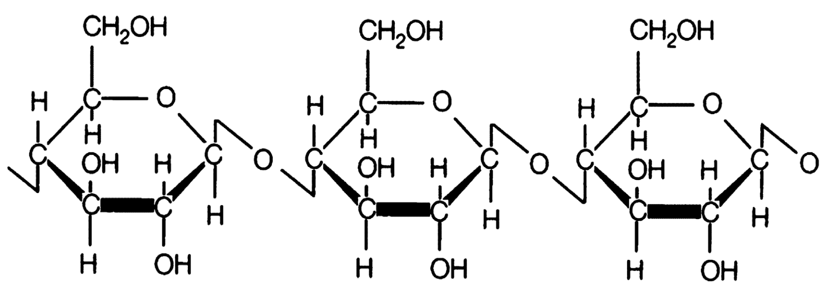


Figure 7. The chemical structure of cellulose.

3.5. Effect of Polyester Blend Ratio on Bursting Strength

The strength (gm/tex), fiber length, and elongation value are responsible for getting a higher bursting value (kPa). The higher the tenacity, length, and elongation, the higher the bursting value. The percentage of polyester in the blend increased by 1% incrementally, from 5% - 19%. The study fabrics with a higher rate of polyester blend ratio showed a better or higher bursting value (kPa) and vice versa [17]. Polyester fiber has excellent mechanical properties and improved bursting strength. The chemical structure of polyester fibers is another factor for the variation of the bursting test value (kPa). Polyester consists of a long-chain polymer. It is chemically at least 85% of the weight of an ester group, an ethylene group (dihydric alcohol), and a terephthalate group [14]. Polyester's filaments and staple forms are strong due to its highly effective vander wall's forces and hydrogen bonds. Consequently, polyester gives higher tensile strength for woven fabrics and higher bursting strength for knit fabrics. **Figure 8** shows the chemical structure of polyester [18].

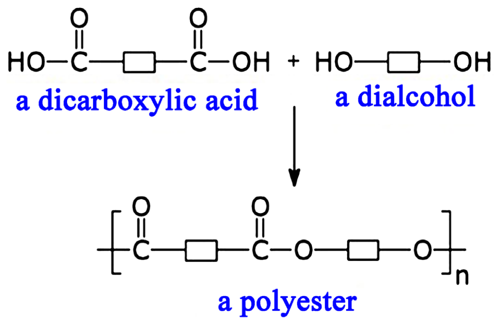


Figure 8. The chemical structure of polyester.

3.6. Effect of Spandex Blend Ratio on Bursting Strength

Spandex comprised 1%, 2%, 3%, 4%, and 5% of the blend. The spandex fiber has a significantly lower tenacity. Because of its reduced tenacity and extremely high stretchability, spandex with blend ratios starting at 1%, 2%, 3%, 4%, and 5% does not contribute to obtaining a specific bursting strength value (kPa). Spandex is a long-chain synthetic polymeric fiber. The soft and rubbery segments allow the fiber to stretch and recover to its original shape, and hard segments provide rigidity and strength [15]. The primary role of spandex is to give comfort and an aesthetic feel instead of directly participating in increasing or decreasing fabric strength (bursting or tensile). **Figure 9** shows the chemical structure of spandex [19].

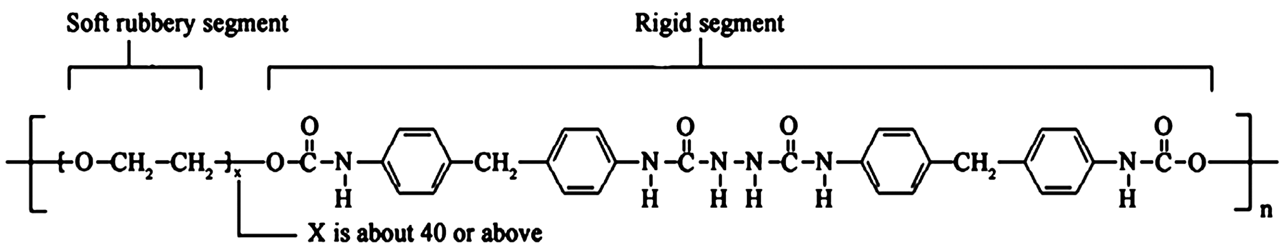


Figure 9. The chemical structure of spandex.

3.7. Statistical Analysis through Pearson Correlation

The Pearson correlation was conducted for group 1, group 2, and group 3 fabrics

[20].

The correlation graph (Figures 10-12) generated from Tables 2-4. In Figure 10, it shows the positive correlation, with a coefficient of 0.8914 for group 1 fabrics. In Figure 11, it shows the positive correlation, with a coefficient of 0.9732 for group 2 fabrics. In Figure 12, it shows the positive correlation with a coefficient of 0.9384 for group 3 fabrics. This means a strong relationship exists between polyester blend proportions and bursting strength test value (kPa).

3.8. Regression Analysis through ANOVA—Group 1 Fabrics

The regression analysis through ANOVA was conducted for group 1, group 2, and group 3 fabrics [21]. A hypothesis statement was prepared before conducting the regression analysis through ANOVA (Analysis of Variance).

H0: There is no relationship between the dependent variable (Bursting Strength)

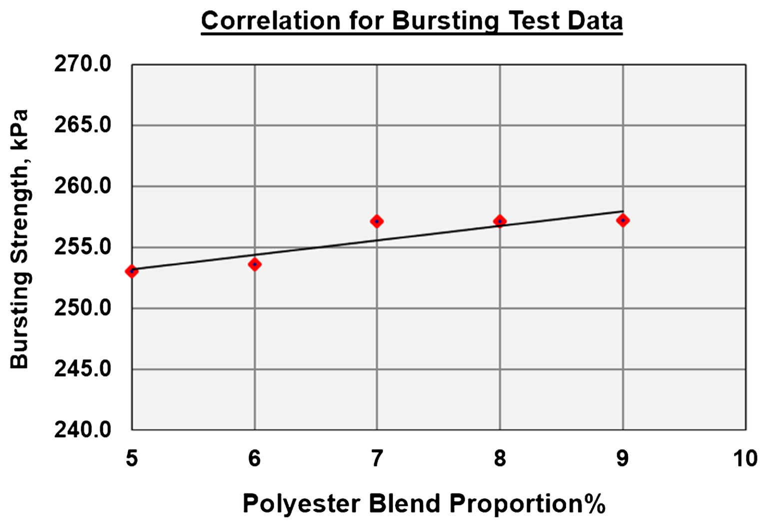


Figure 10. The correlation for Group 1 Fabrics.

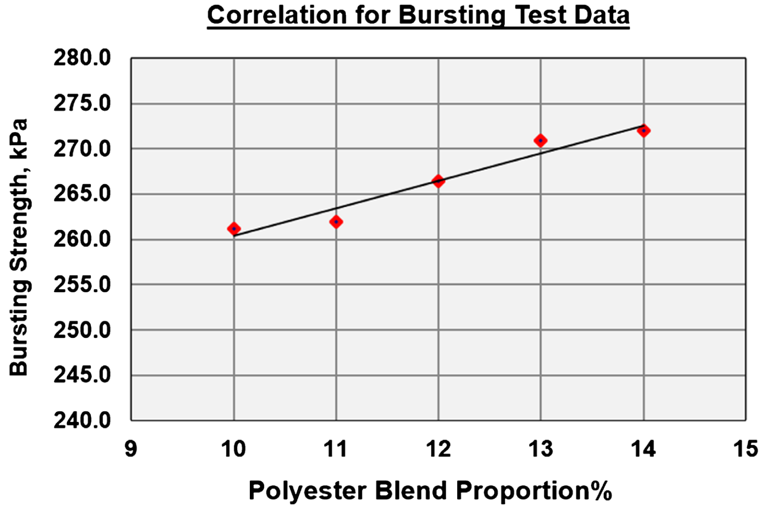


Figure 11. The correlation for Group 2 Fabrics.

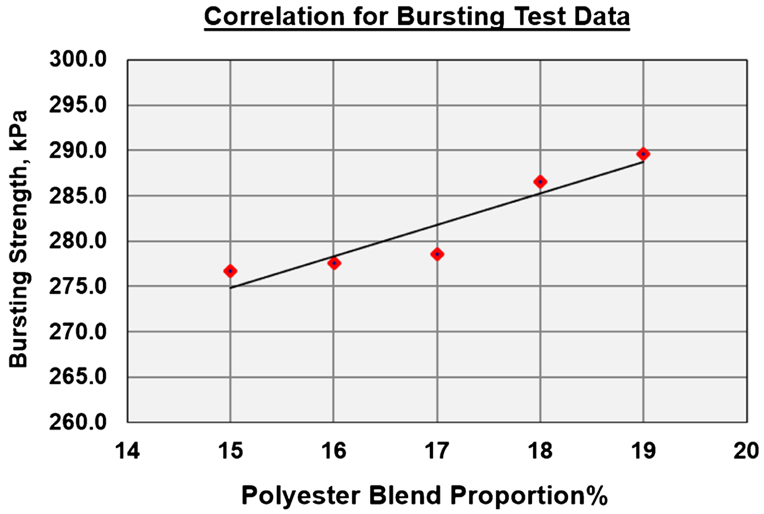


Figure 12. The correlation for Group 3 Fabrics.

and the set of independent variables (Polyester Blend Proportion%).

Ha: There is a relationship between the dependent variable (Bursting Strength) and the set of independent variables (Polyester Blend Proportion%).

Table 5 represented ANOVA for regression and **Figure 13** represented regression graph for group 1 fabrics.

Table 5. ANOVA Table for Regression of Group 1 Fabrics.

Source	DF	Sum of Square S.S.	Mean Square MS	F Statistic (df1, df2)	P value
Regression	1	14.161	14.161	11.6105 (1, 3)	0.04223
Residual	3	3.659	1.2197		
Total	4	17.82	4.455		

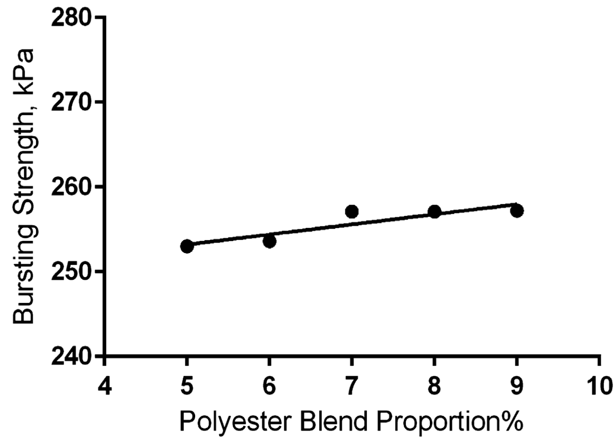


Figure 13. The Regression Graph for Group 1 Fabrics.

The suggested equation for the bursting strength test value for group 1 fabrics is Y = 1.190 * X + 247.3.

The correlation coefficient (R) and the coefficient of determination (R^2) were found to be 0.8914 and 0.7947, respectively. It indicates a strong relationship between polyester blend proportion and bursting strength test value (kPa). From Table 5, it was observed that the p-value (0.04223) < α (0.05). Then, the null hypothesis was rejected. A 95% confidence interval or 5% significance level is chosen for the study. The analysis shows that the regression ANOVA is significant, meaning that the regression equation for group 1 fabric is Y = 1.190 * X + 247.3 is statistically significant.

3.9. Regression Analysis through ANOVA—Group 2 Fabrics

A hypothesis statement was prepared before conducting the regression analysis through ANOVA (Analysis of Variance).

H0: There is no relationship between the dependent variable (Bursting Strength) and the set of independent variables (Polyester Blend Proportion%).

Ha: There is a relationship between the dependent variable (Bursting Strength) and the set of independent variables (Polyester Blend Proportion%).

Table 6 represents ANOVA for regression, and Figure 14 represented regression graph for group 2 fabrics.

Table 6. ANOVA Table for Regression of Group 2 Fabrics.

Source	DF	Sum of Square S.S.	Mean Square MS	F Statistic (df1, df2)	P value
Regression	1	93.636	93.636	53.6904 (1, 3)	0.005251
Residual	3	5.232	1.744		
Total	4	98.868	24.717		

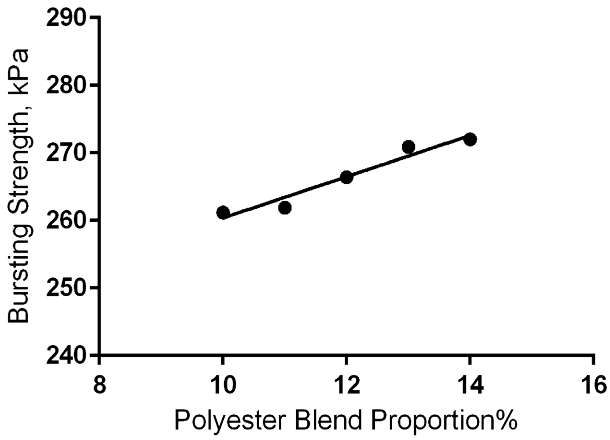


Figure 14. The Regression Graph for Group 2 Fabrics.

The suggested equation for the bursting strength test value for group 1 fabrics is Y = 3.060 * X + 229.8.

The correlation coefficient (R) and the coefficient of determination (R^2) were found as 0.9732 and 0.9471, respectively. It indicates a strong relationship between polyester blend proportion and bursting strength test value (kPa). From Table 6, it was observed that p-value (0.005251) < α (0.05). Then, the null hypothesis was rejected. A 95% confidence interval or 5% significance level is chosen for the study. The analysis shows that the regression ANOVA is significant, meaning that the regression equation for group 2 fabric is Y = 3.060 * X + 229.8 is statistically significant.

4. Regression Analysis through ANOVA—Group 3 Fabrics

A hypothesis statement was prepared before conducting the regression analysis through ANOVA (Analysis of Variance).

H0: There is no relationship between the dependent variable (Bursting Strength) and the set of independent variables (Polyester Blend Proportion%).

Ha: There is a relationship between the dependent variable (Bursting Strength) and the set of independent variables (Polyester Blend Proportion%).

Table 7 represents ANOVA for regression, and Figure 15 represents regression graph for group 3 fabrics.

The suggested equation for the bursting strength test value for group 1 fabrics is Y = 3.45 * X + 223.19.

Table 7. ANOVA Table for Regression of Group 2 Fabrics.

Source	DF	Sum of Square S.S.	Mean Square MS	F Statistic (df1, df2)	P value
Regression	1	119.025	119.025	22.114 (1, 3)	0.01819
Residual	3	16.147	5.3823		
Total	4	135.172	33.793		

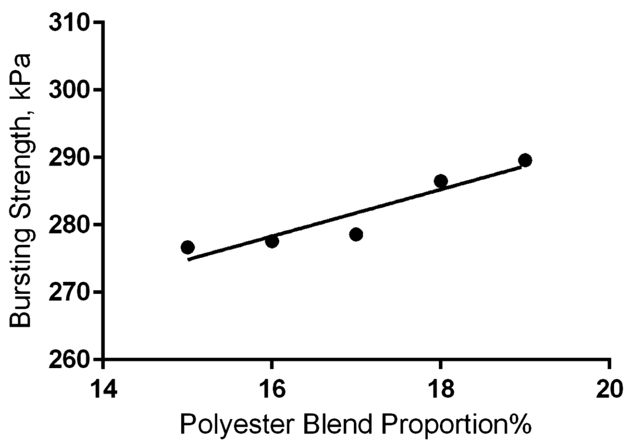


Figure 15. The Regression Graph for Group 3 Fabrics.

The correlation coefficient (R) and the coefficient of determination (R^2) were found to be 0.9381 and 0.8801, respectively. It indicates a strong relationship between polyester blend proportion and bursting strength test value (kPa). From Table 7, it was observed that the p-value (0.01819) < α (0.05). Then, the null hypothesis was rejected. A 95% confidence interval or 5% significance level is chosen for the study. The analysis shows that the regression ANOVA is significant, meaning that the regression equation for group 2 fabric is Y = 3.45 * X + 223.19 is statistically significant.

4.1. Regression ANOVA Summary for Group 1, Group 2, and Group 3 Fabrics

A regression ANOVA summary was prepared for group 1, group 2, and group 3 fabrics.

Table 8 represents the Regression ANOVA Summary for group 1, group 2, and group 3 fabrics.

Table 8. Regression ANOVA Summary Table.

Regression Parameters	Regression Model Data		
	Group 1 Fabrics	Group 2 Fabrics	Group 3 Fabrics
Slope	1.19	3.06	3.45
Y-intercept	247.3	229.8	223.19
R	0.8914	0.9732	0.9384
R^2	0.7947	0.9471	0.8805
Regression Equation Model	Y = 1.190 * X + 247.3	Y = 3.060 * X + 229.8	Y = 3.45 * X + 223.19

4.2. Interpretation of Regression Model for Group 1, Group 2, and Group 3 Fabrics

For group 1 fabric, the regression equation is Y = 1.190 * X + 247.3 is statistically significant. In other words, a positive relationship exists between the polyester fiber blend proportions% and the bursting strength test value (kPa). The regression equation can be written as Bursting Strength (kPa) = 1.190 * Polyester blend proportion% + 247.3. The regression equation shows that a 1% increase in polyester fiber blend proportion will increase bursting strength by 1.190 times. The y-intercept is 247.3, meaning that when x (polyester fiber blend proportion) equals 0, the y (bursting strength value is 247.3 kPa.

For group 2 fabric, the regression equation is Y = 3.060 * X + 229.8 is statistically significant. In other words, a positive relationship exists between the polyester fiber blend proportions% and the bursting strength test value (kPa). The regression equation can be written as Bursting Strength (kPa) = 3.060 * Polyester blend proportion% + 229.8. The regression equation shows that a 1% increase in polyester fiber blend proportion will increase bursting strength by 3.060 times. The y-intercept is 229.8, meaning that when x (polyester fiber blend proportion) equals 0, the y (bursting strength value is 229.8 kPa.

For group 3 fabric, the regression equation is Y = 3.45 * X + 223.19 is statistically significant. In other words, a positive relationship exists between the polyester fiber blend proportions% and the bursting strength test value (kPa). The regression equation was expressed as Bursting Strength (kPa) = 3.45 * Polyester blend proportion% + 223.19. The regression equation shows that a 1% increase in polyester fiber blend proportion will increase bursting strength by 3.45 times. The y-intercept is 223.19, meaning that when x (polyester fiber blend proportion) equals 0, the y (bursting strength value is 223.19 kPa.

5. Conclusions

The high-tenacity polyester fiber dominated the fiber blend, reflected in correlation, regression equation, and regression ANOVA. Considering the actual experimental facts and scenario, the concluding remarks for the study are as follows:

1) The blended fabric's bursting strength value increases as the percentage of polyester increases, and vice versa.

2) The cotton and spandex in blends did not reflect remarkably on the bursting strength.

3) There is no other alternative to choosing the appropriate blend proportion with polyester fibers regarding quality, cost, and sustainability development.

4) The suitable regression equation facilitated the textile manufacturing industry personnel to predict the bursting strength value.

Due to technical limitations, the study used fabrics of three different fibers, cotton, polyester, and spandex, with various percentages of the blend ratio. The future scope is to deal with recycled and virgin fibers with various blend proportions to achieve sustainable development in textile fields.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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