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Article

An Assessment of Structural Attributes of Black and White Printed Printex Textile Fabrics

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Abstract: The purpose of this study was to assess the structural attributes of black and white Printed Printex Textile Fabrics in Ghana. The study adopted a factorial experimental research design. The three fabrics with black prints and white as base colours were purchased from the market. These three fabrics had the same designs but two had different fabric finishes and the third one had no finish (plain, embossed and plisse). Key soap purchased from the Ghanaian market and standard soap from Ghana Standard Authority were used for the study. A purposive sampling procedure was used in choosing the fabrics and soap for the study. Specimens totalling 219 were cut randomly from along the warp and weft directions of the Printex black and white cotton fabric with finishes (plain, embossed and plisse). The use of laboratory experiments and the apparatus used to experiment. The data obtained were presented using both descriptive and inferential statistics. The descriptive statistics (frequencies, percentages, means and standard deviation) were used as summary statistics of variables of the study. The one-way analysis of variance (ANOVA) was used to test for significant differences among three variables (three washing cycles), whereas the independent samples t-test was used to test for statistically significant differences between the performance of the fabric finishes under Key soap and the standard soap. The study indicated that differences in the attributes of the finishes caused differences in the structural attributes of the fabrics. This was because some of the finishes required certain structural attributes to bond well with the fabrics. The implication is that continuous washing weakens the structural attributes of fabrics which causes them to fail or weakens their resistance to stress tests. The study, however, found that differences in the structural attributes of the fabric finishes caused differences in the effects of washing on the selected fabric finishes. It is recommended that Printex Textile Limited should place critical emphasis on the weight of the fibres used in the construction of the fabrics. This was necessary since the study found that the fabric finish with the greatest weight performed better in tensile strength than those with the lowest weight. As a result, the use of fibres with high weight is expected to improve the use and care of the fabric finishes in terms of their ability to resist stress or tension during washing.

Keywords: Structural, Attributes, Black, White, Printex, Textile, Fabrics

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1. Introduction

Clothing is often broadly defined as covering and its related concept is personal adornment, which encompasses any form of bodily decoration or alteration, for example, clothes, paints and make-up [1]. Hence, clothing comprises undergarments, inner garments, outer garments, accessories and cosmetics. The clothes and accessories are made from different types of materials which are largely textile fabrics ranging from natural to synthetic. The 20th Century has produced a textile world in which skilled chemists and engineers have created a fabulous array of fabrics for beauty and ease of living. No matter the use of a fabric, a fabric of any fibre can now be transformed to meet today's demands. One of these transformations is accomplished through the science and art of fabric finishing. Fabric finishing usually starts when cloth comes from the loom or knitting machine. At this point, the cloth is known as grey goods or greige goods. It is a limp, rough, colourless 'rag", full of blemishes and impurities. Selecting from a host of different processes or finishing techniques, the manufacturer converts the grey goods into beautiful fabric, glowing with colour and design, appealing to the touch, sight and functional in use.

Fabrics are not produced in a vacuum but through a logical development of raw material into finished consumer goods. Fabrics are of different types and made into different designs and characteristics that meet consumer needs. To impart the required functional properties to the fibre or fabric, it is customary to subject the material to different types of physical and chemical treatments. There are different types of fabrics which include damask, linen, gingham, crepes, silk, satin, voile, dacron and many others which consumers use for under and outer clothing, bed linens, soft furnishings, accessories like bags, belts, hats, jewellery and many more, depending on their characteristics and properties. Consumers use fabric depending on their needs and the ability of the fabric to meet those needs. Manufacturers therefore try, through various means, to introduce innovative strategies to attract consumers to patronise their products, thus improving the marketability of their fabrics. Some of the strategies include making their prints look more attractive, more serviceable and more saleable [2].

A finish is a treatment applied to the fabric after construction [3]. Also, fibres and yarns can be finished. Fabric finishing covers an extremely wide range of activities, which are performed on fabrics before they reach the final customer. Finishes may be routine, aesthetic or functional. They may be temporary, for example, the way bed sheets are pressed before packing, or they may be permanent, as in the case of flame-retardant and tenting fabrics. Winkle-resistant finish for a cotton fabric is necessary to make it crease-free or wrinkle-free. Similarly, mercerising, singeing, flame retardant, water repellent, waterproof, anti-static and peach finishing are various fabric properties desired by consumers. One or more finishes may be applied to a single fabric [3]. The finishing could involve such techniques as putting a glaze on an upholstery fabric, which gives it a more attractive appearance, or the production of water-repellent finishes, which improves the in-service performance of a tenting fabric. Since many finishes are invisible to the eye, it is not always easy to recognise a specific fabric finish; however, there was an indication that the effects of these finishes are evident in the behaviour of the fabric [4].

Research stated that the aim of fabric finishing may be described as an improvement in customer satisfaction [5]. This improvement in the perceived value of a product to the consumer forms the basis of modern ideas on product marketing. Researchers explained that "the stiffness of organdie, the smooth, silky feeling of batiste, the watered moiré effect on acetate, and the whiteness of table damask are all results of finishing treatments to which the fabrics are subjected after they are made" [3]. Some finishes like napping, brushing, shearing and calendaring are imparted to the fabric so that they would be suitable to sell. A study showed that "enzyme treatment improved the hand values of cotton fabric in terms of the softness, smoothness and stiffness" [2]. It was evident from the study that the bio-finishing process improved the overall hand value of the fabric.

The Ghanaian Textiles Industry ranges from large to small scale and the large industries include Ghana Textile Print (GTP), Akosombo Textile Limited (ATL), Ghana Textile Manufacturing Company (GTMC), Printex and an array of other small-scale industries. The Ghanaian textile prints available on the market comprise wax prints, rotary screen printing (RSP), java, fancy print, batik and tie-dye. These cotton textile prints are categorised according to the methods of manufacture and they are patronised by consumers from all walks of life for various purposes.

However, in recent times, the influx of cheap foreign wax prints on the Ghanaian market has brought about high competition in the textile industry. The competitive nature of the situation has led the textile industries to use a new drive towards high value being added to their textile products. Given this, the textile industries in Ghana have developed new and smart ways to improve their textile prints to satisfy consumers, as well as to capture the market. Some of the smart ways are the use of fabric finishes to add interesting characteristics to fibres, yarns and fabrics by the use of chemical, mechanical or both processes for their products. For instance, "easy care" properties are used for fabrics which require minimum or no ironing and resistance to soiling, staining and other added properties are what the textile industries are using to capture the market because consumers desire.

The use of fabric finishes helps to provide more aesthetic effect, extra comfort and increase in performance of the textile prints. However, Ghana Textile Print (GTP) has introduced a more colourful wax print named "Newstyle" and this print can be used by all and for all types of designs and occasions. Given this innovation, patronage is high by consumers from all walks of life. All the textile industries have adopted versatile ways of printing ~~of~~ their products to meet consumer expectations. Printex, recognizing the high use of black and white prints for well-patronised activities like funerals, marriages, naming ceremonies and festivals, introduced an array of black and white prints. This is widely patronised by all classes of consumers.

The outstanding feature is the captivating use of "adinkra" symbols which has made the fabric more unique in the Ghanaian local scene. Initially, the black and white prints were produced without special finishes, but now, a variety of special finishes have been adopted and used by Printex to meet different income levels and some of them are, embossed, napping, flocking and crepe finishes. In the production process, the textile prints are categorised according to the type of special finish applied to them therefore the type of finish applied informs their corresponding prices right from the manufacturer through to the retailer. Generally, the prices of the textile products are mostly used to judge their quality and for this reason, the black and white prints that are given special finishes cost more than their plain counterparts. People who patronise the special finish black and white prints are therefore perceived as being in a high social class. Clothing as a symbol of status has been of interest to sociologists for many years. Sociologists argued that “for a symbol to be assigned status or prestige by individuals, it must be perceived as both scarce and socially desirable” [6]. The high rate at which consumers are patronising the fabric has prompted the researcher to ascertain the quality and subsequently promote its use and increase their patronage at the global level. To facilitate or increase the products’ acceptance at the global level means producing to meet the standards of the International Organisation for Standards (ISO).

The quest of the textile industry in Ghana to satisfy consumers' desires to have something new has brought about healthy competition among members of the industry. The competition is in the direction of producing a variety of fabrics with contemporary techniques of processing and designing textiles. The textile industry in Ghana is faced with recent imports perceived to be cheap textile prints as compared to made-in-Ghana prints. For the manufacturers to beat their competitors they have developed a new drive towards adding value to their products, culminating in the use of new improved designs and fabric finishes. The fabrics are therefore subjected to various processes to achieve the desired effect. These processes have the potential to reduce performance and other structural attributes. The ease of soiling the fabric especially the white colour in these fabrics due to the activities they are mostly used for is a factor for being subjected to frequent washing, after each use if one wants to maintain a clean fabric before storage. These do not come with care instructions so individuals subject them to varying care treatments.

It is perhaps, important to point out that though research has been done on textile finishing, most of them have focused on functional finishes like durable press, anti-soiling, permanent pleating, flame-resistant finishes and other textile finishes in the developed countries. For example, researchers studied the effect of citric acid with BTCA on durable press performance, but with scanty regard to aesthetic finishes. Little research has also been done on fabric finishes used in Ghanaian textile prints. Therefore, this research sought to find out how three washing cycles in the laboratory affect the structural attributes, of the black and white fabrics with the plain and crepe finishes produced by Printex. In particular, the study sought to find out how the performance of crepe finishes (plain printed, plisse and embossed) used by Printex are affected when subjected to the maintenance procedure of washing. Specifically, the study was interested in finding out whether washing of the textile prints affects the structural attributes, of the black and white Printex textile print with the crepe finishes [6].

1.1. Theoretical Framework

The study was guided by the failure theories of materials, which predict the failure of a material subjected to uniaxial or multi-axial state of stresses, and the basic fibre theory [7]. Every material has a certain strength, expressed in terms of stress or strain, beyond which it fractures or fails to carry the load. A material is said to have failed when it is stressed beyond its elastic limit and permanent deformation occurs. The need to develop products with increased durability and cost-effectiveness has dramatically led to the development of advanced fabric or fibre-reinforced composite materials. The characteristics of such composites permit the material to be tailored to any desired shape while meeting the performance, durability and cost requirements. That is, in terms of being lightweight; having high strength and stiffness-to-weight ratios; and providing good chemical, fatigue and corrosion resistances.

However, to maximise the use of the superior strength and stiffness of composite materials in the designs, the failure mechanisms of composite materials have to be thoroughly understood. There are four failure theories of materials, which are maximum normal stress theory, maximum shear stress theory, maximum strain energy theory and maximum distortion energy theory. The purpose of the theories is to determine the fibre break of the printed black and white plain, plisse and embossed cotton fabrics produced by Printex in Ghana.

1.1.1. Maximum Normal Stress Theory (Rankine's theory)

The maximum normal stress criterion, also known as Coulomb's or Rankine's criterion, is based on the maximum normal stress theory [7]. The theory is adopted to predict the failure of materials or fabrics. Rankine specified that the failure of fabric occurs when the maximum (normal) principal stress reaches the ultimate strength of the fabric for simple tension (either the uniaxial tension strength or the uniaxial compression strength). The theory states that a fabric subjected to any combination of strains or stresses will yield whenever the greatest positive principal stress exceeds the tensile yield strength in a simple uniaxial tensile test of the same fabric or whenever the greatest negative principal stress exceeds the compressive yield strength. The study, therefore, adopted this theory to describe deformations and failures of the printed black and white plain Printex, plisse Printex and embossed Printex undergo stress conditions.

1.1.2. Maximum Shear Stress Theory (Tresca or Guest's Theory)

Maximum Shear Stress theory is also known as Tresca's or Guest's criterion, and it is often used to predict the yielding of fabrics [8]. The theory states that a fabric that is subjected to any combination of stress or strain will fail (by yielding or fracturing) whenever the maximum shear stress exceeds the shear strength (yield or ultimate) in a simple uniaxial stress test of the same fabric. The shear strength is usually assumed to be determined from the standard uniaxial tension test.

1.1.3. Maximum Strain Energy Theory

The total amount of elastic energy absorbed by an element of material is the proper criterion for its yielding. The formulation of this theory indicated that "failure will occur when the strain energy per unit volume due to the applied stress equals the strain energy per unit volume at the yield point in uniaxial testing. Strain energy is, therefore, the energy stored in a material due to elastic deformation". The theory assumes that "fabric failure occurs when the total strain energy for a complex state of the stress system is equal to that at the yield point of a tensile test (Drucker)". That is, failure is assumed to take place when the total strain energy exceeds the strain energy determined from a simple tensile test [9].

1.1.4. Maximum Distortion Energy Theory (Von Mises and Hencky's Theory)

The maximum distortion energy criterion or Maxwell-Huber-Hencky-von Mises theory, is often used to estimate the yield of yielding materials [10]. The theory was used to explain that failure occurs when the energy of distortion reaches the same energy for yield or failure in uniaxial tension of the plain, plisse and embossed black and white Printex cotton textile prints.

1.1.5. Mohr-Coulomb Stress Theory

The Mohr-Coulomb stress criterion is based on the Mohr-Coulomb theory also known as the internal friction theory [4]. A study noted that no material, including fabrics, will sustain an indefinitely large amount of strain or stress. Friction forces play a major role in everyday life [11]. It occurs in every mechanical system, especially when there is a physical interaction between two surfaces brought into contact. The friction is the tangential reaction force between two surfaces brought into contact. The theory describes three different deformations (traction, bending and shearing) of the plain, plisse and embossed black and white Printex cotton textile fabrics. Coulomb's friction model has been made possible by many scientific contributions about the yarn and the fabric traction [12]. Unless any product is characterised by value addition it is impossible to survive in this highly competitive world market. Processing is important to make a product usable but finishing gives value addition to it. Processing makes garment attractive and comfortable, and finishing can incorporate desirable properties [2]. Finishing is, therefore, the heart of textile processing.

2. Materials and Methods

2.1. Methods

The study adopted a factorial experimental research design. The experimental design allowed manipulation of the variables being used [13]. The experiment was handled as a three-by-two-by-two (3x2x2) factorial design. The first factor was the treatment (washing), the second factor was the type of soap used (Key soap and standard soap) and the last factor was fabric types (black and white Printex prints with plain, embossed and plisse finishes which are produced from 100% cotton). These were the parameters adopted in carrying out the study. The study involved more than one variable so; the factorial design was chosen.

2.2. Materials (Population)

Printex fabrics were selected on the basis that, they are the only textile company producing printed black and white cotton fabrics with different fabric finishes. The three fabrics with black prints and white as base colours were purchased from the market. These three fabrics had the same designs but two had different fabric finishes and the third one had no finish (plain, embossed and plisse). Six yards each of the Printex black and white fabrics with embossed, plisse and a third one which did not have any special fabric finish were used for the study. Key soap purchased from the Ghanaian market and standard soap from Ghana Standard Authority were used for the study. Although there are a lot of soaps sold in the Ghanaian market, Key Soap was chosen because it is commonly used by several Ghanaian consumers as was realised in a casual investigation carried out. This survey proved that Key Soap enjoys brand loyalty and has high patronage because of its perceived mild effect on printed textile fabrics. For this reason, Key Soap and standard soap were used for the study.

2.3. Sample and Sampling Procedure

The method employed in carrying out the study was the strip test method. A purposive sampling procedure was used in choosing the fabrics and soap for the study. Specimens totalling 219 were cut randomly from along the warp and weft directions of the Printex black and white cotton fabric with finishes (plain, embossed and plisse). The specimens were cut exactly 7cm x 30cm, which are the required sizes by the International Organisation for Standards (ISO) specific text method. The samples prepared produced 219 specimens for the experimental study. (Refer to Tables 2 and 3). For validity and meaningful conclusions, the study was limited to the black and white fabrics that had the same designs. The pattern cutter was used to cut for weighing to determine the weight of the fabric. They were cut in a standardised circular form from the individual fabrics for the test in both warp and weft directions.

2.4. Research Instruments

Since the study was experimental research, the data were gathered through the use of laboratory experiments and the apparatus used to experiment were a universal tensile testing machine, vivid colour assessment chamber, launderometer, canisters, pattern cutter, greyscale, grey mask, wooden template, weighing scale, spatula, measuring tubes, beakers, drying rack, glass cutter, and pick glass/ counting glass. The wooden template, measuring 7cm by 30 cm, was used to measure the samples for the study. The samples for the test were cut with a pair of sharp shears. The weighing scale TXL/A12/WGS/(Adam equipment) was used to weigh specimens, the grated Key soap and standard soap before washing because the weights of the fabric determine the amount of soap solution to put in each canister before washing. A Spatula was also used to take the amount of grated Key soap needed into the beaker. The amount of water needed to prepare soap solution was measured with measuring tubes in the laboratory. The soap solution was poured into beakers and the beakers were placed in the Eyela water bath to help dissolve the individual soap particles uniformly.

Launderometer (Gyro wash) TXL/A12/GWM/01 model was used to wash the specimens. The launderometer is made up of stainless-steel containers of 550± 50ml capacity which rotate at the rate of 40± 2rpm. Also, the temperature of the water bath was thermostatically controlled to maintain the test solution at the prescribed temperature of ± 2^0C. The washed specimens were dried using a drying rack in the laboratory. A glass cutter (eyepiece) was used to determine the weave in the fabric. The pick glass or counting glass was employed to determine yarn count, and a pattern cutter was used to cut fabrics in circular shapes to determine the weight of individual fabrics. The service colour assessment chamber was used for assessing change in colour complying with 105-A02 and also for assessing staining, complying with 150 (105-A03), and the grey mask was used to stabilise the fabric during measuring.

2.5. Data Analysis

The data obtained were presented using both descriptive and inferential statistics. The descriptive statistics (frequencies, percentages, means and standard deviation) were used as summary statistics of variables of the study. The one-way analysis of variance (ANOVA) was used to test for significant differences among three variables (three washing cycles), whereas the independent samples t-test was used to test for statistically significant differences between the performance of the fabric finishes under Key soap and the standard soap.

3. Results and Discussion

This section presents results and discussion on the Structural Attributes of the (Plain, Plisse and Embossed) Black and White Printed Printex Textile Fabrics. The research objective sought to assess the structural attributes of the three types of finishes on the black and white printed Printex textile fabrics. This was because differences in the structural attributes of the three types of finishes of the fabrics may cause or explain differences in their performance during tensile strength testing (uniaxial testing), dimensional stability when the load is exerted on them and colourfastness. The differences in the fibre properties of textile fabrics are likely to yield different results as they undergo the same strain test. It was, therefore, expected that differences in the structural attributes of the three types of finishes on the black and white cotton Printed textile fabrics from Printex would explain possible differences in their performances as they undergo three washing cycles [14]. The structural attributes considered under the section were yarn count, weave type and weight.

3.1. Thread Count of the Fabrics

The yarn count of the fabrics was considered as fibre theory that the greater the number of yarn counts in a particular fabric, the greater its ability to resist stress-related deformation [15]. The implication is that fabric with the greatest thread count may best resist deformation during uniaxial testing after the three washing cycles with Key soap and the standardised soap. The weight was also considered under the structural attributes of the fabrics because it is generally perceived that heavy fabrics perform better than light-weighted fabrics when they undergo usage and care through washing. The weave types of the fabrics were also assessed because differences in the weave type might inform differences in the performance of fabrics after undergoing tensile strength testing [16]. The analysis of structural attributes was organised under plain, plisse and embossed finishes. Table 5 presents the results on the thread counts of the three finish types of the selected black and white cotton printed textile fabrics from Printex. The aim was to assess the potential capacity of the three finishing types to resist tensile-related deformation and the number of thread counts of fabrics significantly determined their potential capacity to resist stress-related deformation [16]. Table 1 shows that the thread count of the plain finishes ranged from 31 to 32 at the warp yarn direction and 29 to 32 at the weft yarn direction. The mean yarn count at the warp yarn direction was 31.4 with a standard deviation of 0.6, while the mean yarn count at the weft yarn direction was 30.6 with a standard deviation of 1.3.

Table 1. Thread Count of Plain, Plisse and Embossed Finished Printed Printex Textile Fabrics

Number of counts	Plain		Plisse		Embossed	
	Warp	Weft	Warp	Weft	Warp	Weft
First	32	30	34	29	33	31
Second	31	32	34	31	31	29
Third	32	29	37	30	32	29
Fourth	31	32	37	30	32	32
Fifth	31	30	33	32	32	29
Mean yarn count	31.4	30.6	35	30.4	32	30
Standard deviation	0.6	1.3	1.9	1.1	0.7	1.4

Source: Laboratory result, 2014

Similarly, the thread count of the plisse finishes ranged from 34 to 37 at the warp yarn direction and 29 to 32 at the weft yarn direction. The mean thread count at the warp yarn direction was 35 with a standard deviation of 1.1, while the mean thread count at the weft yarn direction was 30.4 with a standard deviation of 1.1. In addition, the thread count for the embossed finish fabric ranged from 31 to 33 at the warp yarn direction, and 29 to 31 at the weft yarn direction. The mean thread count at the warp yarn direction was 32 with a standard deviation of 0.7, whereas the mean thread count at the weft yarn direction was 30 with a standard deviation of 1.4. Comparing the mean yarn counts among the three types of finishes shows that the plisse finished fabric had the highest yarn count (35) at the warp yarn direction, followed by the embossed finished fabric (32) and then the plain finished fabric (31.4). On the weft yarn direction, the plain finished fabric had the highest yarn count (30.6), followed by the plisse (30.4) and then the embossed finished fabric yarn count (30). The central hypothesis in the basic fibre theory is that the properties of fabrics determine their performance during stress tests and that fabrics with high yarn thread counts are more resistant to stress tests than those with low yarn counts.

The implication is that the plisse finished fabric has the highest potential capacity at the warp yarn direction to resist deformation during the uniaxial testing, while the plain finished fabric has the lowest potential capacity. However, the plain fabric has the highest potential capacity at the weft yarn direction to resist the tensile strength test, whereas the embossed finished fabric has the least. The differences in thread counts among the three fabric types imply that the design of the various finishes affects the thread count of the Printex fabrics. Table 1 further shows that the mean thread count at the warp yarns was higher than that in the weft yarns in all three fabric types. Thus, while the mean yarn count at the warp yarn direction for the plain finished fabric was 31.4, the weft was 30.6. Furthermore, while the mean yarn count at the warp yarn direction was 35, the weft was 30.4. The implication is that the fabric will have greater resistance at the warp yarn direction than the weft yarn direction during tensile strength testing as described by basic fibre theory that the number of thread counts in a fabric partly determines its resistance capacity during uniaxial testing. This agrees with a previous study "that the warp yarns of fabrics are always stronger than the weft yarns because they contain more thread counts than the weft yarns" [2].

The study further analysed whether there was a statistical difference in the observed mean scores among the three fabric types of Printex. This was necessary to further help explain variations in the mean scores of other variables such as tensile strength, colourfastness and dimensional stability. One-way analysis of variance was used to assess the statistical significance among the three observed means for the warp yarns and the other three for the weft yarn direction. The results are presented in Table 2. The descriptive results are associated with the ANOVA test.

Table 2. Testing of Significant Difference in Thread Count among the Three Types of Finishes of Printex Textile Fabrics

Yarn direction	Df	MS	F	P-value
Warp	14	18.6	12.98	0.001
Weft	14	0.47	0.27	0.76

Source: Laboratory result, 2014

From Table 2, the observed differences in the means of the three types of finishes on Printex fabrics were statistically significant (f = 12.98, p = .001). This was because the p-value was within the acceptable margin of error of 0.05. The significant difference in the thread counts at the warp yarns of the three fabric types shows that the company does not use a common fabric base in the manufacturing of the three different fabrics. This is likely to have caused significant differences in the performance of the three fabrics during washing or tensile strength testing.

On the other hand, the weft yarn direction (as shown in Table 2) shows that the observed differences in means among the three finishing types of Printex fabrics were not statistically significant ($F = 0.27$, $P = .76$). This could be due to the closeness in the thread counts of the three fabric finishes. The plain finished fabric recorded 30.6, the plisse finished fabric had 30.4, whereas the embossed finished fabric recorded 30 as the thread counts in the weft yarns. Thus, there were not many differences in the thread counts of the three fabric finishes. This could result in a similar performance at the weft yarn's direction during washing or tensile strength testing in the three fabric types.

3.2. Weight of the fabrics

As part of the examination of the structural attributes of the three finishes of the printed Printex textile fabrics, the weight of the fabrics was measured. The aim was to find differences in the weight of the three finishes of printed Printex textile fabrics. This was necessary because it is perceived that differences in the weight of fabrics may result in differences in the performances of the fabrics as they undergo washing or uniaxial testing. The results on weight were organised under the three finish types. For each finished fabric, three different fabric weights were taken and the mean was calculated for the analysis. The aim was to improve the accuracy in the determination of the weight of the specimens. Table 3 presents the detailed results.

Table 3. Weights of Plain, Plisse and Embossed Finished Printed Printex Textile Fabrics

Number of times	Plain	Plisse	Embossed
First	128.44 g/m^2	127.55 g/m^2	134.21 g/m^2
Second	124.23 g/m^2	120.63 g/m^2	130.89 g/m^2
Third	123.42 g/m^2	124.42 g/m^2	128.85 g/m^2
Mean weight	125.36 g/m^2	124.2 g/m^2	131.32 g/m^2
Standard deviation	2.70	3.47	2.71

Source: Laboratory result, 2014

Table 3 shows that the weight of the plain finished Printex fabrics ranged from 123.42g/m^2 to 128.44g/m^2 with a mean weight of 125.36g/m^2 and a standard deviation of 2.70. Similarly, the weight of the plisse-finished Printex fabrics ranged from 120.63g/m^2 to 127.55g/m^2 with a mean weight of 124.2g/m^2 and a standard deviation of 3.47. Further, the weight of the embossed finished Printex fabrics ranged from 128.85g/m^2 to 134.21 with a mean weight of 131.32g/m^2 and a standard deviation of 2.71. The results show that the embossed finished Printex fabrics had the highest weight, followed by plain finished Printex fabrics and then the plisse finished Printex fabrics. Per the central hypothesis of the basic fibre theory, the results imply that the embossed finish of Printex fabrics has the highest potential capacity to pose resistance to uniaxial testing, while the plisse finish of Printex fabric has the least.

The study tested whether there were statistically significant differences among the observed mean weights of the three types of Printex fabrics. This was important because the significance of the difference would further be used to explain the significance of the differences in the tensile strength and dimensional stability of the three selected Printex fabrics. One-way analysis of variance was used to assess the significance of the difference. This was because there were three independent sampled means to be compared. The descriptive results associated with the analysis are presented in Table 4.

Table 4. Testing of Significant Difference in Weight among the Three Types of Finishes of Printex Textile Fabrics

Source of Variation	SS	Df	MS	F	P-value
Between Groups	87.44	2	43.72	4.93	0.05
Within Groups	53.18	6	8.86		
Total	140.62	8			

Source: Laboratory results, 2014

Table 4, shows that the observed differences in means among the three types of Printex fabrics (plain, plisse and embossed) were statistically significant ($F = 4.93$, $p = .05$). The differences in weight could however be attributed to the differences in the thread count of the fabrics. An earlier study posits that "there is a positive correlation between thread count and weight of fabrics from the same fibre source" [17].

The significant difference in weight among the three Printex fabric finishes implies that Printex Textile Company does not use a common fabric base in the manufacturing of the three fabric finishes. This could be due to the different finishing effects on the fabrics. A similar study explained that "fabric manufacturers use different physical fabric properties to achieve different effects in the finishes". The aim sometimes is to ensure proper bonding between the fabric and the finishing improving the usability of the fabric. The significant difference in weight is therefore likely to have a significant effect on the performances of the fabrics during tensile strength testing that differences in the physical fabric properties result in differences in their performance during usage or uniaxial testing [19].

3.3. Weave Type of the Three Fabric Types

Another structural attribute considered under the research objective was the weave type. This was imperative because differences in the weave may cause significant differences in the performances of fabrics during uniaxial testing. Thus, similar research emphasised, "that the weave type of fabrics influences cohesion between fibres which also affects the performance of the fabrics during stress test" [20]. The study however found that the entire weave for the three fabric types of the selected Printex fabrics was plain. The implication is that the weave type of the fabrics could not cause any significant differences in the performances of the fabrics as they undergo washing and tensile strength testing.

4. Conclusions and Recommendations

The study indicated that differences in the attributes of the finishes caused differences in the structural attributes of the fabrics. This was because some of the finishes required certain structural attributes to bond well with the fabrics. The implication is that continuous washing weakens the structural attributes of fabrics which cause them to fail or weakens their resistance to stress test. The study, however, found that differences in the structural attributes of the fabric finishes caused differences in the effects of washing on the selected fabric finishes. It is recommended that Printex Textile Limited should place critical emphasis on the weight of the fibres used in the construction of the fabrics. This was necessary since the study found that the fabric finish with the greatest weight performed better in tensile strength than those with the lowest weight. As a result, the use of fibres with high weight is expected to improve the use and care of the fabric finishes in terms of their ability to resist stress or tension during washing.

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