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Research Article
Development of Cotton, Hemp and Silk Blended Curtains for Designer Home Interiors

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Abstract

Background and Objective: Curtains are now used for more than just providing seclusion and blocking light. Nowadays, people use curtains in their residences or places of business to express their personal style or to give the space a little extra flair. More people than ever are interested in interior design and many like employing contemporary colours and ideas to decorate their homes or other unique spaces. **Materials and Methods:** In this research, cotton-silk blend and hemp-silk blend yarns were used to develop curtain fabric with a blend ratio of (60:40). These six curtain fabrics were made on a rapier jacquard loom with a twill structure. Physical tests have been done in this research work according to the ISO/AATCC standard, like colour fastness to perspiration, colour fastness to dry cleaning, colour fastness to rubbing, light fastness and a tensile strength test. **Results:** Color fastness when rubbed under both dry and wet conditions differs only slightly between all samples of cotton and silk blend and all hemp and silk blends in this research work. Color fastness to dry cleaning is found to be of good scale grade in all samples of cotton-silk blend textiles when compared to all samples hemp-silk blend fabrics. Overall, color fastness other related tested performance shows slight variation for cotton-silk and hemp-silk blend curtain dyes fabrics. **Conclusion:** Hemp-silk and cotton-silk blend curtain textiles offer great performance and colour appearance overall. So that curtain fabric can be used more effectively in the field of house interior design.

Key words: Curtain, colour fastness to water, rubbing, light, perspiration, dry cleaning

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

These days, curtains serve more purposes than only obstructing light and granting seclusion. Nowadays, people use curtains in their residences or places of business to express their personal style or to give the space a little extra flair[1-4]. More people than ever are interested in interior design and many like employing contemporary colours and ideas to decorate their homes or other unique spaces. People can discover information and advice on things to consider when purchasing curtains for their homes. Naturally, blocking out the sun during the day and other light at night is a concern, so it's critical to get it right the first time by considering your home's location and how the sun impacts it. Use drapes that complement the room's design and atmosphere or add colour and vibrancy to a particular region to improve the look and feel of the space[5-8]. Color may convey an atmosphere for a certain area, so if you want to use a window curtain to adorn a room where you like to read, relax and have some quiet time, choose a colour for the curtain that will help you unwind rather than going with vibrant hues. Important considerations to make include the curtain fabric's colour and pattern[9-12]. There are a variety of designs available, including some that are playful, serious and calm. Therefore, consider the final product and the atmosphere you want to create in the room before making your choice. The textiles used for home furnishings are referred to as home textiles. Sheets and pillowcases, blankets, terry towels, curtains, table cloths, carpets and rugs are some examples of fundamental things. The textiles used for the home are made of both natural and synthetic fibres, such as cotton, linen, rayon, silk, wool, polyester, or blends of any two or all of these fibres[13-16].

This research work looked at the color fastness to dry cleaning, perspiration, water, light, rubbing and rubbing, as well as the tensile strength of curtain fabrics made with cotton-silk, hemp-silk and silk yarns that were woven into twill structures. However, there is no published research on the performance properties of curtain fabrics made with various types of cotton-silk, hemp-silk blend, or silk yarns. This study aims to fill this gap by contributing to the study of how the types of cotton-silk, hemp-silk and silk yarns affect the ability of woven fabrics made with these yarns to keep their colours when exposed to perspiration, water, light and rubbing.

MATERIALS AND METHODS

Study area: All this research work was done from 10th March, to 21st July, 2022 in the local textile industry area of Varanasi, India. This yarn has developed at the Sangam Pvt. Ltd. Company. Fabric has been produced by the Varanasi local industry.

Materials: In this study, the qualities of curtain textiles made with cotton-silk, hemp-silk blend and silk yarns with twill structures were studied in terms of colour fastness to dry cleaning, colour fastness to sweat, colour fastness to water, colour fastness to light, colour fastness to rubbing and tensile strength (Fig. 1(a-b) and 2(a-b)). The fabrics were made on a rapier jacquard loom as shown in Table 1 and 2.

Fig. 1(a-b): Hemp-silk blend certain fabric cotton-silk blend certain fabric

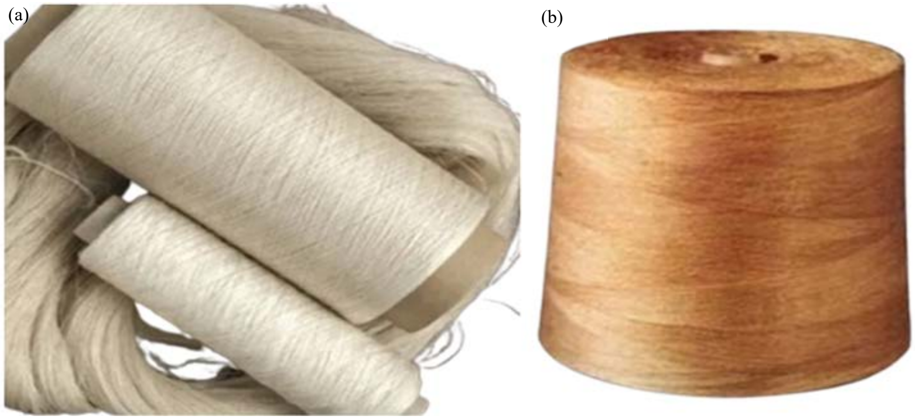

Fig. 2(a-b): (a) Cotton+silk blend yarn and (b) Hemp+silk blend yarn

Table 1: Fibre (cotton+silk) composition details

Specifications details	
Test standard	ISO 1833-1 2006 (EU 1007/2011)
Composition	60% cotton, 40% silk fibre
Warp fibre	Cotton+silk
Weft fibre	Silk

Table 2: Fibre (hemp+silk) composition details

Specifications details	
Test standard	ISO 1833-1 2006 (EU 1007/2011)
Composition	60% hemp, 40% silk fibre
Warp fibre	Hemp+silk
Weft fibre	Silk

Source original by author

The EPI (ends per inch) and PPI (pick per inch) have been measured according to the ASTM D-3775 standard. Fabric GSM means grams per square meter were measured according to ASTM D-3776. It is an important property of the fabric. The more GSM the garments more weight and the less GSM the garments lighter weight. The cotton-silk blend and hemp-silk blend curtains fabric in warp Yarn denier have kept constant at 22 denier and weft Yarn denier have kept constant at 50 denier for comparable fabric properties as shown in Table 3.

Methods

Colour fastness to dry cleaning: The ISO 105-D01:2010 describes a way to find out how well the colour of all kinds of textiles holds up when dry-cleaned with perchloroethylene solvent. This method is not good for figuring out how long textile finishes will last, nor is it meant to be used to figure out how well colours stand up to the methods used by the dry cleaner to get rid of spots and stains[17].

Colour fastness to perspiration: One of the main textiles used for colour fastness testing is the capacity of the coloured cloth to withstand sweat (both acidic and alkaline) without fading or staining. The importance of a clothing product's colour fastness to perspiration test cannot be overstated because, in daily life, fabrics that are tightly fastened to the skin for an extended period of time come into touch with the sweat produced by the skin and risk transferring dyes to the skin. The general colour fastness to sweat test technique used in these standards is ISO 105 E04: 2013[9,17,18].

Colour fastness to water: Color fastness to water is a term used to describe how well dyed, printed, or other coloured textile yarns and textiles withstand exposure to water. The test procedure used for this test is ISO 105 E01: 2010. This technique is used to gauge the potential for cross-staining when damp clothing is left in touch[9,17,18]. The test gauges a fabric's water resistance, regardless of colour.

Colour fastness to light (xenon arc lamp): A method for assessing how an artificial light source xenon arc lamp (Unuo Instruments, company name and manufacturing by China) that simulates natural daylight affects the colour of textiles of all types and in all shapes is described in ISO 105-B02:2014 (D65). White (bleached or optically brightened) textiles can also use the technique[9,17,19]. Using two independent sets of blue wool references is possible with this technique. It's possible that the two different sets of references produced different outcomes.

Along with a collection of reference materials, a sample of the textile being examined is exposed to artificial light in controlled circumstances. By contrasting the test specimen's colour change with that of the employed reference materials, the colour fastness is evaluated. The numbers 1 through 8 designate blue wool references created and produced in

Table 3: Fabric specifications

	Yarn type		Yarn count/D				
Fabric	Warp way	Weft way	Warp way	Weft way	EPI	PPI	GSM
Curtain fabric	Cotton+silk	Silk	22 Denier	50 Denier	126	82	110
Curtain fabric	Cotton+silk	Silk	22 Denier	50 Denier	121	77	120
Curtain fabric	Cotton+silk	Silk	22 Denier	50 Denier	118	72	130
Curtain fabric	Hemp+silk	Silk	22 Denier	50 Denier	124	86	110
Curtain fabric	Hemp+silk	Silk	22 Denier	50 Denier	122	80	120
Curtain fabric	Hemp+silk	Silk	22 Denier	50 Denier	116	76	130

EPI: End per Inch, PPI: Pick per inch and GSM: Gram per square meter

Europe. These examples are items of blue wool that have been dyed. Each reference with a higher number is almost twice as fast as the one before it. They range from 1 (extremely poor colour fastness to light) to 8 (very high colour fastness to light). Colour fastness to rubbing (xenon arc lamp).

The method for assessing a textile's color's resistance to rubbing off and staining other materials is outlined in ISO 105-X12:2016[9,17,19]. This standard applies to all types of textiles, including pile fabrics and textile floor coverings. The technique can be used to create textiles from any type of fibre in the form of yarn or fabric, including printed or coloured textile floor coverings[20]. There are two possible tests: one using a dry rubbing cloth and the other using a wet rubbing cloth.

The method defined in ISO 105-X16:2016 is for determining the resistance of the colour of textiles to rubbing off and staining other materials when it is necessary to single out regions that are too small to test with the equipment described in ISO 105-X12. There are two possible tests: One using a dry rubbing cloth and the other using a wet rubbing cloth.

Tensile strength: The grab test, which is a method for determining the maximum force of textile textiles, is described in ISO 13934-2:2014[9,17]. The technique is most suited to woven textile textiles, particularly those that have been mechanically or chemically treated or have elastomeric fibres present that give them stretch qualities. It is adaptable to fabrics made using other methods geotextiles, nonwovens, coated fabrics, textile-glass woven fabrics and fabrics made of carbon fiber or polyolefin tape yarns are not affected by this rule. According to the procedure, the maximum force of test specimens in equilibrium with the testing standard atmosphere and test specimens in a wet state must be found. The method can only be used with testing tools that have a constant rate of extension (CRE).

Tearing strength: The ballistic pendulum (Elmendorf) method for calculating the tearing strength of textile is described in this section of EN ISO 13937[9,17]. The technique explains how to quantify the force needed to cause a single-rip tear to propagate from a cut in a cloth when a sudden force is applied. The test primarily applies to woven fabric types.

Statistical analysis: Using Minitab statistical software version 1.110.0, each result was statistically assessed. Methods for assessing the hypothesis included the One-way Analysis of Variance (ANOVA) test. The p-values less than 0.05 were considered statistically significant.

RESULTS AND DISCUSSION

Colour fastness to dry cleaning: A textile sample in contact with cotton fabric/multi-fibre and non-corrodible steel discs is agitated in perchloroethylene, compressed and then air-dried. The standard greyscale is used to detect any colour change in a specimen. The hue of the solvent is then evaluated. Under conditions of 30 min of mechanical agitation at 30°C in perchloroethylene solution, samples are dry-cleaned[21]. The samples' colour fastness to dry cleaning was summarized in Table 4. On the acetate, cotton, nylon, polyester, acrylic and wool multi-fibre bands observed in a solvent, a slight colour shift and absence of staining were observed. On cotton-silk blend curtain fabrics and hemp-silk blend curtain fabrics, excellent dry-cleaning grading was observed.

Colour fastness to perspiration: Determine the colour fastness of textile materials to perspiration. This applies to all types of dyed, printed and coloured textile filaments, yarns and fabrics. Test samples of pigmented textiles are soaked in a perspiration-simulating solution. After being subjected to a predetermined mechanical pressure, it is allowed to slowly dry at a slightly elevated temperature in the presence of a multi-fibre fabric. Additionally, any colour transfer is assessed[21-23].

Table 4: Colour fastness to dry cleaning test results

		Staining in colour					
Sample	Change in colour	Wool	Acrylic	Polyester	Polyamide	Cotton	Acetate
S1	4	4.5	4.5	4.5	4.5	4.5	4.5
S2	4	4.5	4.5	4.5	4.5	4.5	4.5
S3	4	4.5	4.5	4.5	4.5	4.5	4.5
S4	4	4.5	4.0	4.5	4.0	4.0	4.5
S5	4	4.5	4.5	4.0	4.5	4.5	4.0
S6	4	4.5	4.0	4.5	4.0	4.0	4.0

Table 5: Colour fastness to perspiration (acid) test results

		Staining in colour					
Sample	Change in colour	Wool	Acrylic	Polyester	Polyamide	Cotton	Acetate
S1	4	4.5	4.5	4.5	4.5	4.5	4.5
S2	4	4.5	4.5	4.5	4.5	4.5	4.5
S3	4	4.5	4.5	4.5	4.5	4.5	4.5
S4	4	4.0	4.0	4.5	4.0	4.0	4.5
S5	4	4.5	4.0	4.0	4.5	4.0	4.5
S6	4	4.0	4.5	4.5	4.0	4.5	4.0

Table 6: Colour fastness to perspiration (alkali) test results

		Staining in colour					
Sample	Change in colour	Wool	Acrylic	Polyester	Polyamide	Cotton	Acetate
S1	4.5	4.5	4.5	4.5	4.5	4.5	4.5
S2	4.5	4.5	4.5	4.5	4.5	4.5	4.5
S3	4.5	4.5	4.5	4.5	4.5	4.5	4.5
S4	4.0	4.0	4.5	4.0	4.0	4.5	4.0
S5	4.5	4.0	4.0	4.5	4.0	4.5	4.5
S6	4.0	4.5	4.5	4.0	4.5	4.0	4.0

Table 7: Colour fastness to water test results

		Staining in colour					
Sample	Change in colour	Wool	Acrylic	Polyester	Polyamide	Cotton	Acetate
S1	4	4.5	4.5	4.5	4.5	4.5	4.5
S2	4	4.5	4.5	4.5	4.5	4.5	4.5
S3	4	4.5	4.5	4.5	4.5	4.5	4.5
S4	4	4.0	4.0	4.5	4.0	4.5	4.0
S5	4	4.5	4.5	4.5	4.0	4.5	4.5
S6	4	4.0	4.5	4.0	4.5	4.0	4.5

The perspiration values for the test samples were presented in Table 5 and 6, multi-fibre bands comprised of acetate, cotton, nylon, polyester, acrylic and wool were exposed to acidic and alkaline solutions and exhibited minimal colour shifts and no discolouration. Hemp-silk blended curtain fabrics and cotton-silk blended curtain fabrics had an excellent perspiration rating.

Colour fastness to water: This test method is created and put into use to gauge the water resistance of coloured, printed, or dyed textile yarns and textiles. Because tap water's composition varies, distilled or DE-ionized water is used in this instance. Multi-fibre test cloth is submerged in water and then placed between glass or plastic plates under specific pressure, temperature and time requirements. On the basis of the specimen's changing colour and the staining of the attached multifiber test, observations were made[11,21]. There is only a slight variation in the colour fatness values of samples S1 to S3 and S4 and S6, respectively as shown in Table 7. The findings of the samples' colour fastness to water tests were displayed in Table 7. The multi-fiber band made of acetate, cotton, nylon, polyester, acrylic and wool on the water showed a slight colour shift but no stains. On the cotton-silk blends and hemp-silk blends fabrics, excellent water grading was seen.

Colour fastness to light: The light source for the scene was a xenon arc lamp. The sample was exposed to light alongside blue wool standards for the duration necessary to cause

Table 8: Colour fastness to light xenon arc lamp test results

Sample	Colour fastness to light (Test methods ISO 105X12:2016) Xenon arc lamp	
	Colour change @ BWS	Grade Index
S1	4	4
S2	4	4
S3	4	4
S4	4	4
S5	4	4
S6	4	4

BWS: Blue wool scale

Table 9: Colour fastness to rubbing xenon arc lamp test results

Sample	Colour fastness to rubbing (Test methods IS 105X12:2016) Xenon arc lamp	
	Dry (Rubbing)	Wet (Rubbing)
S1	4.5	4.5
S2	4.5	4.5
S3	4.5	4.5
S4	4.5	4.0
S5	4.0	4.5
S6	4.5	4.0

Table 10: Shrinkage behaviour of all dyed samples

Sample	Shrinkage (%)	
	Length (%)	Width (%)
S1	-2.1	-2.3
S2	-2.0	-2.2
S3	-2.4	-2.3
S4	-2.7	-2.4
S5	-2.4	-2.4
S6	-2.6	-2.2

fading of 4 on a grey scale. The faded sample was then graded in comparison to the blue wool standards, with ratings ranging from L-2 to L-9. A chosen specimen is subjected to simulated sunshine for a specific amount of time in order to test the resistance to colour change caused by exposure to sunlight. The change in colour is then observed. The colour fastness to light was shown in Table 8. The cotton-silk blends and hemp-silk blends materials showed no colour change after being exposed to a certain amount of light for evaluation[21].

The definition of light-fastness is the resistance to fading when exposed to light. It is discovered that all samples S1 to S6 have the same grade 4 colour fastness to light according to Table 8. Finally, the colour fastness to light performances of all samples is excellent.

Colour fastness to rubbing: The quantity of colour transfer from a test specimen to other surfaces is assessed using wet and dry rubbing. It is not advised to use this rubbing on carpets. Under supervised circumstances, a coloured specimen is rubbed with a white crock test cloth. The motion of a human finger and forearm is mimicked in this rubbing motion. The AATCC grey scale is used to evaluate colour transfer and a rating is given. The ratings for colour fastness against rubbing dry and wet stains were displayed in Table 9. Excellent ratings for both dry and wet staining were given to all samples, no staining was seen. On the S4 and S6 samples, there was very slight staining.

Shrinkage: All samples (S1 to S6), according to Table 10, showed roughly equivalent amounts of shrinkage qualities both lengthwise and widthwise. All sample shrinkage ranges were within the acceptable range and no significant variations were observed. For producing clothes, the shrinkage value of roughly 3% was acceptable.

Tensile properties: The change of tensile strength and tearing strength as a function of dyeing after dyeing on receptive 6 fabric samples (S1 to S6) was shown in Tables 11 and 12. From these tables, it has been observed that tensile strength and tearing strength were changed.

In order to test a textile's colour fastness against dry cleaning, it must come into contact with one or more specified neighbouring fabrics and be mechanically agitated in a soap solution under specified time and temperature conditions before being washed and dried. The grey scales are used to evaluate the specimen's colour change as well as the staining of the nearby fabric[21,23].

Table 4, demonstrated that S1 to S3 samples (cotton-silk blend textiles) have colour fastness to dry cleaning that is a good scale grade (4 to 4.5) when compared to S4 to S6 samples (hemp- silk blend fabrics). Due to the coordinated bonding that the S1 to S3 fabric samples create with dyed fibres, which cannot break while dry cleaning.

All of the dyed curtain samples show no evidence of staining (Tables 5 and 6), however, cotton-silk mix curtain textiles are more durable for comparison with hemp-silk blend curtain fabrics. Finally, the performance of all samples' colour fastness to perspiration is good generally[21,23]. There were no significant changes in the colour fastness to perspiration in acid or alkali (Table 5 and 6).

This indicates that S1 to S3 have slightly greater water fastness ratings than S4 to S6. Because the S1 through S3 samples represent the development of the dye-fibre link between the fibre and the dyes as shown in Table 7.

Finally, we have observed that all S1 to S6 curtain fabrics have very good colour fastness to light properties. Cotton-silk blend curtain fabrics and hemp-silk blend curtain fabrics are slight variations, but overall, both have equal colour fastness to light.

Table 11: Tensile strength test results

Fabric direction	Tensile strength properties	S1	S2	S3	S4	S5	S6
Lengthwise	Max. breaking force (lbs)	22.81	23.84	27.74	23.55	24.21	28.54
Widthwise	Max. breaking force (lbs)	41.52	44.25	55.25	43.45	46.74	57.24

Table 12: Tearing strength test results

Fabric direction	Tensile strength properties	S1	S2	S3	S4	S5	S6
Lengthwise	Max. breaking force (lbs)	2.98	3.04	3.45	2.89	3.14	3.57
Widthwise	Max. breaking force (lbs)	3.91	4.14	4.22	3.87	4.14	4.36

This indicated that S1 to S3 have slightly greater water fastness ratings than S4 to S6. Because the S1 through S3 samples represent the development of the dye-fibre link between the fibre and the dyes as shown in Table 9.

Overall, the value is very good, this curtain fabric does not shrink, so the overall shrinkage and appearance after washing properties are very good. This fabric will be used more for curtain fabrics in the future.

According to (Table 11 and 12), we have observed that overall, the S1 to S6 curtain samples have slightly changed in strength. Because this is dependent on the fabric's GSM range, count of yarn and type of fibres used for fabrics, Finally, all curtain samples (S1 to S6) are very good tensile strength properties found in Table 11 and 12.

All this research has found that this is novelty work for curtain fabrics and this research will help all researchers doing this work with hemp, cotton and silk blend fabrics. According to previous literature and research studies, no researchers have done comparative studies with cotton-silk curtain fabrics in hemp-silk blends to date.

Implication: Lastly, this research will help make it easier to make curtain fabrics with a mix of cotton silk and hemp silk, as well as give researchers more motivation to do their work. Because previous research study and survey work has not been done by researchers in hemp-silk blends with comparative studies with cotton-silk, then this is a big step for curtain fabrics and it will definitely help consumers, buyers and researchers. Finally, this is totally new research work. This study discovered that cotton blend silk and hemp blend silk made curtains have minor differences in colour properties, implying that hemp will be used instead of cotton fibre in the future. Because market demand for cotton is higher than supply, this research will be finding an alternate use for hemp instead of cotton.

CONCLUSION

Color fastness to dry cleaning is found to be of good scale grade (cotton-silk blend textiles) samples when compared to (hemp -silk blend fabrics) samples. Finally, the performance of all samples' colour fastness to perspiration is good. In acid or alkali, there were no significant changes in the colour fastness of perspiration. According to that, there is only a slight variation in the colour fastness and rubbing fastness values of all samples of cotton-silk and hemp-silk blend curtain fabrics, respectively. All sample shrinkage ranges were within the acceptable range and no significant variations were observed. Overall, the performance and colour appearance of Hemp-silk and cotton-silk blend curtain fabrics are excellent. so that we can better utilise curtain fabric in the home interior design field.

SIGNIFICANCE STATEMENT

This study will better utilize curtain fabric in the home interior design field. We will in future develop this design catalog our product curtain fabric so that this curtain product will be more helpful for consumers and buyers and also be beneficial to researchers who will do similar studies in the future.

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