INFLUENCE OF MASS OF KAPAS AND ITS FIBRE PROPERTIES ON FABRIC QUALITY

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Abstract:

The impact of mass of kapas and its fibre properties on fabric quality has been studied using four different carded yarn samples namely 'Below 100mg', '100–150mg', '151–200mg' and Normal sample of 50 s Ne for the production of handloom fabrics. All the fabric samples have been produced with uniform process parameters and their tested as per the standard procedure for durability, aesthetic characteristics, and colour fastness properties. It is observed that the mass of kapas and its fibre properties significantly affect the fabric quality.

Keywords:

cotton, fibre properties, fabric quality, mass of kapas

1. Introduction

Cotton possesses many qualities that make it a good textile fibre. Its dominant position as a textile raw material is primarily due to its versatility for a wide range of end uses it can be put to. The interesting feature of cotton, however, is the wide variation in most of its inter and intra fibre properties [1].

The variation in fibre properties (particularly in short fibre content, fibre fineness, maturity, nep content per gram) in a particular fibre group is very high because the mass of locules and kapas collected from a particular location with respect to a particular variety has very high variation, approximately in the range of 200–2200mg and 10–270mg respectively [2-3].

Reduction in variation of fibre properties can be achieved easily by categorization of kapas with respect to their mass (i.e., allow only a limited range of mass of kapas for a particular yarn production). Fibres of a particular mass of kapas must be processed separately, from ginning to spinning, for a particular yarn count for a particular application. This will give better results not only in the quality of product but also in the process performance [4].

The separation of the locules with respect to their mass with consideration of the total number of kapas results in the categorization of kapas with respect to their mass and thus leading to the categorization of fibres with respect to their physical properties. The mass variations of kapas separated from locules of lower mass are significantly higher, compared with variation of kapas separated from locules of heavier mass. Irrespective of the number of kapas within a locules the mass of kapas plays a vital role in deciding the fibre properties [2].

Therefore the categorization of kapas with respect to their mass prior to ginning in the existing sequence of cotton yarn manufacturing (as a carded process) in the textile industry can help to achieve a remarkable improvement in the correct and effective utilization of raw material for the producing a particular quality of yarn and fabric and also to achieve an excellent quality of yarn and fabric without using the combing process [4]. The relation between average count and weight/m [2] with each of the three strength parameters namely tensile, tearing and bursting strength, has been found to be highly significant [5] and also with increase in yarn fineness, twist multiplier and pick level, there is a decrease in tear strength [6]. According to millard, the factors affecting the tear strength are: (i) strength of yarn, (ii) smoothness of yarn, (iii) number of thick places, and (iv) number of yarn slubs [7]. Morton and turner observed that increase in the twist factor of component threads increase the tear strength of fabrics because of increase in thread strength and decrease in yarn diameter, the latter allowing a degree of freedom of the yarn [8].

The picking periods also significantly affect the fibre and yarn qualities. Better fibre and yarn can be achieved by excluding the fibres from the last few picking periods [9].
It is observed that there is a significant impact due to the average mass of seed in a particular picking period on fibre quality. The average mass of seed in a particular picking period determines the quality of fibres picked from that picking period [10].

On the whole the mass of kapas significantly affect the quality of fibre, yarn and fabric. In this regard an experiment was conducted to study the impact of mass of kapas on fabric quality.

2. Materials and Methods

2.1. Materials

The method adopted for the preparation of fibres for the production of yarn samples were reported in an earlier paper [4].

The yarn samples namely 'Below 100mg', '100–150mg', '151–200mg' and Normal sample of 50s Ne (carded yarn) were used for the production of handloom fabrics. The fabric samples were produced carefully from the above yarns with uniform process parameters:

Warp count	:	50s (Singles)
Weft count	:	50s (Singles)
Ends per inch (EPI)	:	84
Picks per inch (PPI)	:	68
Grams per square meter (GSM)	:	76.33
Weave	:	Plain

The earlier-mentioned construction using 50 s Ne seems to be the highest possible construction that could be achieved using handloom machine, and thus the GSM of the fabric is almost closer to the GSM of Normal apparel fabric.

2.2. Methods

The four different handloom fabric samples namely 'Below 100mg', '101–150mg', '151–200mg' and Normal sample were dyed using reactive dye (bi functional colours) in the dyeing house. The sequence of steps followed for dyeing is shown in Figure 1.

Process	Description
Enzyme desizing ↓	Group 3 enzyme (hydrolases) is used. As the reaction is catalysed by the formation of two products from a substrate by hydrolysis.
Washing ↓	Immediately after enzyme desizing the sample is subjected to a hot wash followed by a cold wash.
Wetting agent ↓	The sample is boiled with Caustic Soda in such a way that the water placed on the fabric easily spreads and have lower contact angle.
Washing ↓	The fabric sample after boiling is subjected to a hot wash followed by a cold wash.
Drying ↓	The sample after washing is subjected to drying under room temperature.
Mercerisation ↓	Higher concentration of caustic soda (19–26% solutions) is used. It not only completely removes the motes that have escaped in scouring and bleaching but also give a luster effect.
Washing ↓	The fabric sample after mercerizing is subjected to a hot wash followed by a cold wash.
Maintaining pH ↓	By using the pH paper the pH in the fabric sample is determined, recommended pH is 7 (neutral).
Check for absorbancy ↓	A drop of water is placed on the fabric and the time required for the specular reflectance of the drop to disappear is measured.
Dyeing using reactive dye	Bifunctional colour is used and dyeing is carried out based on the ISO standard 3.

Fig.1. Sequence of steps followed for dyeing

2.2.1. Fabric Testing

The following fabric test was carried out as per the standards:

Assessment	**Standard Number**
Fabric Durability Tests	
Tensile strength	IS-1969-1968
Tearing strength	IS-6489-1971
Abrasion resistance	IS-12673-1989
Bursting strength	IS-1966-1975
Fabric Aesthetic Characteristics Properties	
Flexural rigidity	IS-6490-1971
Bending modulus	IS-6490-1971
Crease recovery	IS-4681-1968
Fabric drape	IS-8357-1977
Colour Fastness Properties	
Laundering	AATCC-61-1A-2003
Crocking	ATCC-8-2004
Light	AATCC-TM-16-2004
Special Test	
Spray test	IS-390-1975

3. Results and Discussions

The properties of fabric have been discussed in terms of three parameters namely, fabric durability, aesthetic characteristics and colour fastness properties. In addition to this fabric spray test is also discussed.

The discussion of durability of fabric includes tensile strength, tearing strength, abrasion resistance and bursting strength, and the fabric aesthetic characteristics includes flexural rigidity, bending modulus, crease recovery and fabric drape. Similarly the colour fastness of fabric includes fastness against laundering, crocking and light. The special test deals only about spray test results.

An excellent change in yarn properties was noticed with respect to fibre properties. A significant enhancement in yarn quality was noticed particularly in the samples '101–150mg' and '151–200mg' when compared with Normal sample. Therefore the incorporation of the process namely categorization of kapas with respect to their mass prior to ginning gives excellent enhancement in yarn quality as well as in process performance [4]. Similarly, interesting results were obtained with the consideration of fabric properties in relation to mass of kapas and its corresponding fibre properties.

3.1. Durability Properties

3.1.1. Fabric Tensile Strength

Fabric tensile strength and elongation percentage of four different samples were shown in Table 1. The fabric produced from the yarn of sample '151–200mg' shows excellent results

Table 1. Fabric fastness properties

Samples	Colour fastness to commercial laundering							Colour fastness to crocking		Colour fastness to light
	Change in colour	Staining on acetate	Staining on cotton	Staining on nylon	Staining on polyester	Staining on acrylic	Staining on wool	Dry	Wet	
Below 100mg	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	1.5
100-150mg	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4	1.5
151-200mg	4	4	4	4	4	4.5	4.5	4.5	4.5	2
Normal	4.5	4	4	4	4.5	4.5	4.5	5	4	2

Table 2. Fabric durability and aesthetic properties

Samples	FABRIC DURABILITY CHARACTERISTICS						FABRIC AESTHETIC CHARACTERISTICS				
	Abrasion resistance	Bursting strength kg/cm^2	Direction of Test	Tensile strength (kg)	Elongation %	Tearing strength (kg.m)	Flexural rigidity mg.cm	Bending Modulus kg/cm^2	Crease Recovery angle (°)	Fabric drape coefficient	
										Face	Back
Below 100mg	10	3.9	Warp	30.0	9.3	0.608	359.7	159.8	36	0.73	0.74
			Weft	26.0	18.7	0.408	73.2	32.5	34		
100-150mg	13	5.8	Warp	35.5	12.5	0.672	265.4	81.0	35	0.81	0.78
			Weft	19.0	25.0	0.496	78.6	26.2	37		
151-200mg	15	5.6	Warp	40.0	12.5	0.656	196.1	65.5	30	0.71	0.72
			Weft	29.0	25.0	0.576	74.0	29.9	34		
Normal	13	5.2	Warp	31.5	12.5	0.704	247.1	135.4	32	0.74	0.74
			Weft	26.5	25.0	0.496	73.2	32.5	35		

when compared with the other samples in both warp and weft direction. The tensile strength and elongation percentage of fabric samples in warp direction shows higher value, as when compared with that in the weft direction, even though the count of yarn in both direction are same. This is because the ends per inch is significantly higher when compared with picks per inch. Tensile strength of Normal and 'Below 100mg' samples are almost similar. Therefore it is clear that the inclusion of fibres from the kapas of lower mass with higher and nominal mass leads to deterioration of fabric quality, particularly in tensile strength. The tensile strength of fabric samples increases gradually with fibres of increase in mass of kapas because within a particular variety longer fibre becomes stronger, highly matured and has higher weight per unit length (i.e., µg/inch). In general heavier kapas includes longer, stronger, highly matured and higher weight per unit length of fibre.

3.1.2. Fabric Tearing Strength

The tearing strength of fabric samples was shown in Table 2. Similar to tensile strength, the tearing strength of fabric samples in warp direction shows higher value when compared with those in weft direction. The fabric produced from the yarn of sample 'Below 100mg' shows poor results when compared with other samples in both warp and weft directions. The range of differences between the samples of '100–150mg', '151–200mg' and Normal was very minimum in warp direction when compared with that in weft direction. But in the weft direction the tearing strength of fabric samples increases gradually with fibres of increase in mass of kapas.

3.1.3. Fabric Bursting Strength

The fabric bursting strength is shown in Table 2. The fabric samples namely '100–150mg', and '151–200mg' shows improved results when compared with the other samples. Similar to the tearing strength results, the sample 'Below 100mg' shows significantly poor results even if compared with the Normal sample. This gives the insight that the elimination or the exclusion of fibres of lower mass of kapas is essential for the enhancement of process performance as well as for the product quality.

3.1.4. Fabric Abrasion Resistance

Similar to tensile, bursting and tearing strength, the abrasion resistance is superior in the fabric sample '151–200mg' when compared with other samples, and the results are shown in Table 2. On the whole the durability property is superior in the sample '151–200mg' when compared with other samples, similarly poor durability property was noticed in the sample 'Below 100mg' even if compare with the Normal sample.

Therefore from the earlier discussion it is clear that for the production of fabric with good durability properties it is essential to have fibres that are of highly matured, higher length, higher strength and higher weight per unit length (µg/inch) because the earlier durability results for the '151–200mg' sample shows improved and consistent result when compared with that for the other samples.

Also it is clearly understood that for a sample to have good durability it must be highly matured and possess higher length. From the above durability test it is observed that the sample of '151–200mg' shows a consistent result comparatively and it is clear that as the fibre length increases the maturity of the fibre increases, leading to good strength of the yarn.

3.2. Aesthetic Characteristic Properties

The unexpected and more interesting result was obtained in the case of aesthetic characteristic property.

3.2.1. Fabric Flexural Rigidity

The fabric flexural rigidity of four different samples is shown in Table 2. The impact of mass of kapas and their fibre properties on fabric flexural rigidity is significant in the case of warp direction when compared with weft direction because the picks per inch is significantly less when compared with ends per inch, due to this impact of mass of kapas and their fibre properties on flexural rigidity is not able to identify clearly. Therefore the fabric with lower PPI or EPI it is very difficult to identify the impact of other factor on fabric flexural rigidity. The sample 'Below 100mg' shows higher flexural rigidity when compared with other samples. But the sample '151 – 200mg' shows poor flexural rigidity value when compared with other samples. In general the short fibres within a particular variety becomes lower in strength, immature and lower in weight/ unit length. But fibers with such characteristic show significantly higher flexural rigidity value when compared with other samples. Similarly the longer, stronger, highly matured and higher weight/unit length fibres from which produced fabric shows significantly poor rigidity value when compared with other samples. This is because the longer fibre easily bends with its own weight when compared with short fibre and also the weight/unit length of fibre is higher in the case of '151–200mg' sample. Not only that the weight per unit length of fibre in the case of sample 'Below 100mg' is significantly lower and also the amount of short fibre content is significantly higher when compared with other samples [4]; this intern leads to increase in the number of fibres in the yarn cross section, and hence the increase in flexural rigidity of fabric. The normal sample also shows higher flexural rigidity when compared with the sample '151–200mg'. This is due to the inclusion of fibres of lower and nominal mass of kapas because the quantity of fibres of lower and nominal mass of kapas is around 80% within a particular fibre group.

3.2.2. Fabric Bending Modulus

The results of bending modulus of fabric was obtained as similar to flexural rigidity, the results are shown in Table 2.

3.2.3. Crease Recovery and Fabric Drape

Apart from the fabric construction parameter such as EPI and PPI, the impact of mass of kapas and their fibre properties on fabric crease recovery and drape is significant because the change in result are significant in both warp and weft direction in crease recovery value and also face and back surface in drape co-efficient. The sample '100–150mg' shows higher recovery angle when compared with other sample in weft direction and the sample 'Below 100mg' and '100–150mg' shows higher recovery angle when compared with other samples in warp direction. Therefore on the whole the sample '100–150mg' is good for considering the recovery angle. Similarly the sample '100–150mg' shows higher drape coefficient when compared with other samples in both face and back surface. A considerably remarkable result was obtained in fabric aesthetic properties. The fabric which is made up of fibres of shorter length (immature, low strength, and low µg/inch) shows preferably good result when compared with the fibres of higher length (mature, high strength, and higher µg/inch), and hence this result makes us to understand clearly that the fibre length is the major factor in determining the properties of the fabric and hence this proves the usefulness of the categorization of kapas [2] with respect to their mass. Hence from this discussion fibres from kapas of lower mass are much preferable to have good aesthetic properties in the fabric, which is shown in Table 2.

3.3. Fabric Fastness Properties

From the study made on the earlier-mentioned samples, we also achieved an interesting result that the fastness properties to laundering, crocking and light test carried at different samples do not have any remarkable change in the fabric characteristic. As per the grey scale rating used for the colour fastness to washing values, the percentage of staining has been given in such a way that the value '1' stands for very poor, value '2' stands for poor, value '3' stands for fair, value '4' stands for good and finally the value '5' stands for excellent. On the basis of the above rating the colour fastness value for commercial laundering at 40ºC and colour fastness value for crocking fall between 4 and 5, which means all the sample fall in the category between good and excellent in their behaviour towards the two test. In the case of colour fastness to light the results falls between 1.5 and 2, which means there is considerable amount of staining in all the samples, hence there is no remarkable change in the fastness properties. The results are shown in Table 1.

3.4. Spray Test

From the results obtained from the spray test carried out on all the four samples, it is clear that the impact of spray test on fabric sample was Nil because the fabric construction parameter like cover factor is low, therefore this is not sufficient to achieve remarkable result and thus our result is zero. But on the other hand as the process was carried out in a handloom operation this was the possible construction that could be achieved using fine count, 50 s Ne hence we could not obtain any remarkable results from the spray test.

4. Conclusion

The fibres from kapas of heavier mass are more suitable for the production of fabric with excellent durability characteristics. The fibres from kapas of lower mass are more suitable for the production of fabric with excellent aesthetic characteristic properties. The fibres from kapas of nominal mass are more suitable for the production of fabric with balanced durability and aesthetic characteristic properties. For considering mass of kapas and their fibre properties, there is no significant impact on fabric fastness properties. On the whole the mass of kapas and their fibre properties significantly affect the fabric quality.

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