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A Comparative Study Of Physical Properties In Two Different Cotton Fabrics

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Abstract

Cotton fiber which is know as the white gold of India, has highest physical and chemical properties than other natural fibers. The cultivation of cotton is carried out in many ways, the one among them is cultivating it with no fertilizers and pesticides but only with the natural rainfall is known as Kala cotton (Gossypium herbaceum). This withstands any temperature and so its cultivated quickly. Blending of cotton fiber with other natural or manmade fiber has become common now a days. Banana Fiber has high range of tear resistance and overall flexibility, blending this fiber with cotton enhances the more physical and chemical properties. This study is carried out to compare the abrasion resistance using Marindale method and Bursting Strength of Banana cotton and Kala cotton fabrics.

Keywords: Cotton fiber, Gossypium herbaceum, Banana fiber, Abrasion resistance, Marindale method, Bursting Strength.

1. Introduction

Millions of Indians depend on cotton farming for their daily subsistence. India cultivates Gossypium arboreum, Gossypium herbaceum, Gossypium hirsutum, and Gossypium barbadense, which are the four primary varieties of cotton. The only nation that grows all four of these species is India. Gossypium herbaceum, commonly referred to as "Kala Cotton," may be grown in regions with high temperatures and little water supply, although its culture is essentially the same as that of any other cotton (1). This characteristic strengthens the cotton strands. Because it is grown without the use of chemical fertilizers, the land is protected from harsh chemicals and its fertility is increased. “The revival of kala cotton on a larger scale requires consistent demand,

along with protection from being copied on powerloom. There's also the danger of organic cotton yarn being replaced by cheap non-organic cotton available in the market," - Laheru. (2)

Cotton has a good variety of physical and chemical capabilities; blending it with other natural or man-made fibers helps reduce the cost of the final fabric. Blending cotton with other fibers is done to achieve desired features. To provide a unique texture look, blending is done prior to spinning (3). Clothes using banana fiber feels cozy and doesn't cause allergies. In addition, it is greaseproof, heat, water, and fire resistant. Because the fabric is made of a sturdy, tough exterior substance, it is reasonably strong. In terms of spin ability and tensile strength, banana fiber excels over all other organic fibers. The ecology is impacted by banana fiber. Because banana fabric production is so highly sustainable, it belongs to a certain category of natural fiber production. "Americans believe cotton is best, but we've invented new fabrics that will change your lifestyle" - Tadashi Yanai. (2)

Natural hollow fibers, cotton has the qualities of being cool, supple, breathable, and absorbent. Water may be held in cotton fibers 24–27 times their own weight. They are resilient to high temperatures, abrasion wear, and dye absorption. Cotton is, to put it simply, cozy. Cotton wrinkles, therefore adding polyester to it or finishing it permanently offers cotton clothing the right qualities. To maximize the qualities of each fiber, cotton is frequently combined with other fibers like polyester, nylon, linen, and wool (3).

The ability of materials and structures to tolerate abrasion is referred to as abrasion resistance. It is a process of using friction to wear something down or scrape it away. This capability aids in maintaining the material's original composition and appearance (8). Mechanical wear is resisted by abrasion resistance. In situations where wear is a concern, abrasion-resistant materials are beneficial for both moving and stationary components. Concrete's compressive strength is closely related to its abrasion resistance. Compared to weak concrete, strong concrete is more resistant to abrasion. Many test techniques can be used to assess a material's or structure's abrasion resistance (6).

An essential mechanical characteristic that gauges a material's capacity to bear stress or pressure without cracking or bursting is its fabric burst strength. It plays a crucial role in establishing the fabric's durability, quality, and suitability for different uses (10). a structure created when two or more sets of strands are interlaced, usually in a pattern that is predetermined and at right angles to one another, with at least one set of strands parallel to the axis along the fabric's lengthwise direction (7).

2. Materials and Methods

Banana cotton and Kala cotton are the two fabrics used for the study. This is a comparative study made to analyze the better abrasion resistance and Bursting strength present among the two fabrics.

2.1 Abrasion Resistance

By utilizing the Marindale technique (ISO 12947-2: 1999) The adaptable Martindale abrasion tester can perform numerous abrasion and pilling tests. Abrasion, which is the rubbing away of the fabric's individual yarns and fibers, is only one type of wear. Throughout their lives, fabrics are exposed to abrasion, which can cause wear, deterioration, damage, and a decrease in performance. But wear performance or durability is influenced by a number of factors, of which abrasion resistance is just one. Sand rubbing into the upholstery fabric and fabric-to-fabric rubbing while sitting are two examples of the various ways that abrasion can happen (3–4). Correlating wear or use conditions of textile abrasion with a laboratory test is a difficult task.

Figure – 01 Abrasion Tester

Circular specimens are abraded against a standard fabric under known pressure in a Martindale abrasion resistance tester. Under known pressure and abrasive action conditions, abrasion resistance is measured by rubbing the specimen in the shape of a geometric figure, known as Lissojous motion, which is a straight line that gradually widens into an elipse and then forms another straight line in the opposite direction and traces the same figure again (ASTM D 4966). The fabric sample receives abrasion in all directions, which is a benefit of the Martindale abrasion test. Surface friction causes stress to develop along the fiber from the force acting transverse to the fiber axis; the amount of surface friction developed is directly correlated with the harshness of standard worsted fabric abradant.

Before **After**

Plate – 01 Abrasion Resistance – Banana Cotton

Before **After**

Plate – 02 Abrasion Resistance – Kala Cotton

S.no	Sample wt. before abrasion (mg)		No. of abrasion cycle		Sample wt. after abrasion (mg)		Wt. loss	
	BC	KC	BC	KC	BC	KC	BC	KC
1.	150	170	30	30	135	150	15	20
2.	150	160	30	30	140	140	10	20
3.	160	170	30	30	150	140	10	30
4.	150	160	30	30	135	130	15	30
5.	160	170	30	30	145	150	15	20

Table – 01 Weight loss after abrasion of Banana cotton and Kala Cotton

The apparatus consists essentially of two aluminum plates supported by four pillars. A ball cater on top of each pillar holds a steel ball. These allow the top plate to be easily moved. Each of the four perpendicularly oriented slots on the top plate holds a filter and a sample holding clamp. The mushroom-shaped sample holders move horizontally on the plate, allowing them to glide vertically. A sample holder that is individually rubbed against a different surface supports one of the four small abrasive tables, each of which has a flat surface parallel to the plate. For the abrasion test, a circular cut is made in the sample. The circular form, which is fixed in a mushroom-shaped holder, has a diameter of 38 mm or 140 mm. Each sample was run through five repetitions, the fabric's weight was recorded both before and after the abrasion, and the difference in value was computed to determine the outcome.

2.2 Bursting Strength

Testing for bursting strength determines how much pressure a material can bear before failing. After that, the quality of the content is assessed to see if it satisfies international standards using the information provided. Put another way, producers can make sure that their goods will withstand the rigors of transportation and reach their destination undamaged by

measuring the bursting strength of corrugated material. (4)

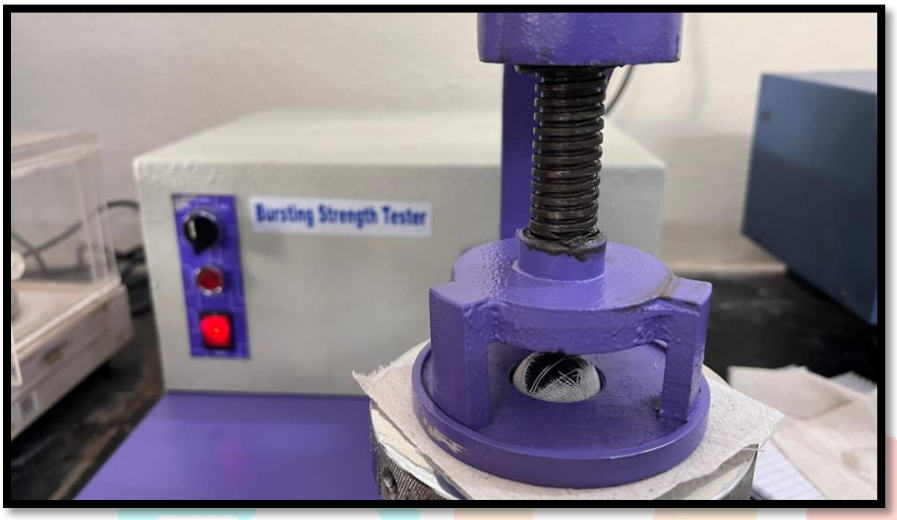

Figure – 02 Bursting Strength Tester

S.no	Bursting strength	
	Banana Cotton	Kala Cotton
1.	9.5	7
2.	8	7
3.	9	6
4.	8	7
5.	8.5	7

Table – 02 Bursting Strength

A sample is compressed in a tiny area until it bursts under the pressure of a bursting strength tester. Next, the pressure needed to cause a rupture is measured and recorded. This test guarantees that the product won't be harmed during transportation, which makes it crucial for quality control. Because of this, bursting strength measurement is crucial to the production of premium corrugated packaging. (5)

3. Results and Discussion

The evaluation of two different physical properties for Kala Cotton and Banana Cotton has been carried out to find which sample withstands the highest level of physical property.

3.1 Abrasion resistance - Banana cotton & Kala cotton

The table below represents the Abrasion resistance value of Banana cotton and Kala cotton in 5 reps. Before and after weight of the fabric has been calculated to bring out the wear index value for each sample of Banana cotton and Kala cotton.

S.No	Banana cotton		Kala cotton	
	Before (mg)	After (mg)	Before (mg)	After (mg)
1	150	135	170	150
2	150	140	160	140
3	160	150	170	140
4	150	135	160	130
5	160	145	170	150

Table – 03 Abrasion Resistance of Banana cotton & Kala cotton

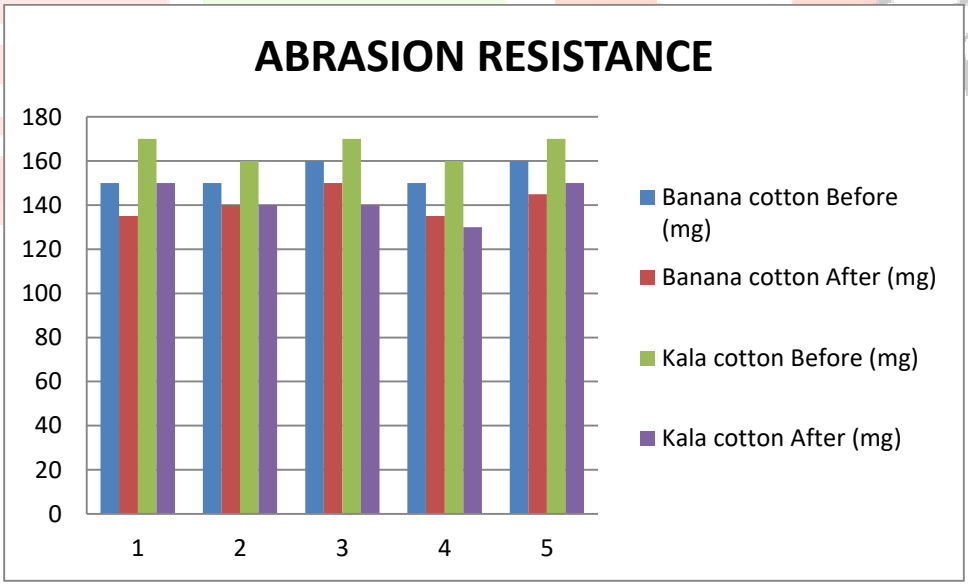

Figure – 03 Abrasion Resistance of Banana cotton & Kala cotton

The above table and graph shows the difference of weight before and after abrasion of the Banana Cotton fabric. BC1, BC2, BC4 has the same value weighing before abrasion where as BC3 and BC5 has the same value weighing before abrasion. The weight of the sample after abrasion has moderate reduction. For Kala Cotton the table and graph shows the difference of weight before and after abrasion of the Kala Cotton fabric. KC1, KC3,

KC5 has the same value weighing before abrasion where as KC2 and KC4 has the same value weighing before abrasion. The weight of the sample after abrasion has moderate reduction. Thus it is observed that Kala cotton has better abrasion resistant than Banana cotton.

3.1.1 Wear Index of Banana Cotton & Kala Cotton

S.no	Sample wt. before abrasion (mg)		No. of abrasion cycle		Sample wt. after abrasion (mg)		Wt. loss		Wear index	
	BC	KC	BC	KC	BC	KC	BC	KC	BC	KC
1.	150	170	30	30	135	150	15	20	4.5	6
2.	150	160	30	30	140	140	10	20	3	6
3.	160	170	30	30	150	140	10	30	3	9
4.	150	160	30	30	135	130	15	30	4.5	9
5.	160	170	30	30	145	150	15	20	4.5	6

Table – 04 Wear Index of Banana cotton

Calculation:

Wear Index for BC S.no 1

$$\text{Wear Index of BC} = \frac{\text{No. of Cycle} \times \text{Wt. loss}}{1000}$$

$$= \frac{30 \times 15}{100} = 4.5$$

Result:

Wear Index for BC S.no 2 = 3

Wear Index for BC S.no 3 = 3

Wear Index for BC S.no 4 = 4.5

Wear Index for BC S.no 5 = 4.5

Calculation:

Wear Index for KC S.no 1

$$\text{Wear Index of KC} = \frac{\text{No. of Cycle} \times \text{Wt. loss}}{1000}$$

$$= \frac{30 \times 20}{100}$$

$$= 6$$

Result:

Wear Index for KC S.no 2 = 6

Wear Index for KC S.no 3 = 9

Wear Index for KC S.no 4 = 9

Wear Index for KC S.no 5 = 6

3.1.2 Comparison of Banana Cotton and Kala Cotton

S.No	Wear Index	
	Banana Cotton	Kala Cotton
1	4.5	6
2	3	6
3	3	9
4	4.5	9
5	4.5	6

Table – 05 Comparison of Wear Index of Banana cotton & Kala cotton

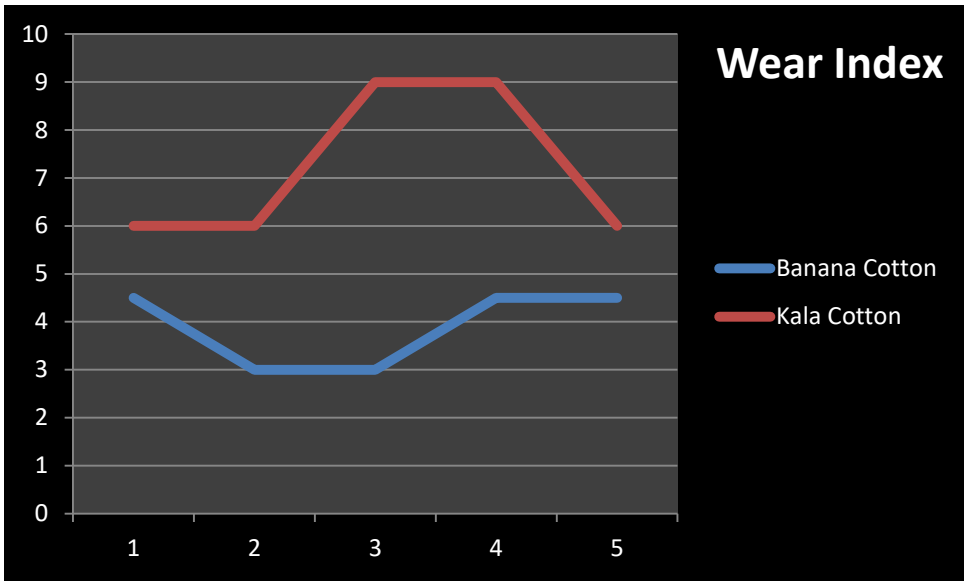

Figure –04 Comparison of Wear Index of Banana cotton & Kala cotton

Thus above table and graph represents the comparison of the wear index value of Kala cotton and Banana cotton. Its seen from the graph that the Kala cotton fabric higher weight loss in contact with abrasion whereas Banana cotton has lesser weight loss to abrasion compared to the above samples.

3.2 Bursting Strength – Banana Cotton & Kala Cotton

The table below represents the Bursting Strength value of Banana cotton and Kala cotton in 5 reps. Kg/cm^2 is the unit value in which the bursting strength has been calculated. The higher value represents the good bursting strength property.

S.no	Bursting Strength kg/cm^2					
	Banana Cotton	**$(x-\bar{x})$**	**$(x-\bar{x})^2$**	**Kala Cotton**	**$(x-\bar{x})$**	**$(x-\bar{x})^2$**
1	9.5	0.9	0.81	7	0.2	0.04
2	8	-0.6	0.36	7	0.2	0.04
3	9	0.4	0.16	6	-0.8	0.64
4	8	-0.6	0.36	7	0.2	0.04
5	8.5	-0.1	0.01	7	0.2	0.04

Table – 06 Bursting Strength Tester

Calculation:

Banana Cotton

$\bar{x} = \sum x \div n$

$43 \div 5 = 8.6$

$SD = \sqrt{\sum (x-\bar{x})^2 \div (n-1)}$

$SD = \sqrt{0.34} \div 4 = 0.29$

$CV = (SD \div \bar{x}) * 100 = (0.29 \div 43) * 100$

$CV = 0.67$

Result:

Bursting Strength = 43

SD = 0.29

CV = 0.67

Kala Cotton

$\bar{x} = \sum x \div n$

$34 \div 5 = 6.8$

$SD = \sqrt{\sum (x-\bar{x})^2} \div (n-1)$

$SD = \sqrt{0.8} \div 4 = 0.44$

$CV = (SD \div \bar{x}) * 100 = (0.44 \div 34) * 100$

$CV = 1.29$

Result:

Bursting Strength = 34

SD = 0.44

CV = 1.29

4. Conclusion

This comparative study was carried out to identify the better abrasion resistant and bursting strength among Kala cotton and Banana cotton. For abrasion resistance the test was done in 5 reps for each sample, where before and after weight of the sample was calculated to find out the wear index which helps to determine the value of abrasion resistance. The calculation of wear index shows the sample BC1, BC4, BC5 has 4.5 wear index value and BC2,BC3 has 3 wear index value, whereas KC1,KC2,KC5 has 6 wear index value and KC3, KC5 has 6 wear index value, higher the wear index value denotes the higher weight loss after abrasion. Thus it is concluded that the Banana Cotton fabric has high weight loss to abrasion that that of the Kala cotton. The bursting strength, SD and CV value of KC is better than the BC values, thus it is concluded that Kala Cotton has better bursting strength that Banana Cotton.

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