iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5315

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

An Analysis of the Dimensional Properties of Various Regenerated Knitted Fabrics at Different Stages

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Abstract: Textiles play such an important role in our everyday lives and people have used textiles of various types from the earliest times to cover, food, personal ornamentation and even to show personal property. Cotton has found much use in the clothing and fashion industry since time immemorial. Therefore the need to develop new fibers came for cotton. Natural fibers have been used in textiles for hundreds of years. Then artificial fiber production came into being. A cloth is a versatile substance that is heavily influenced by its own weight, causing significant deflections. Besides weaving, knitting is the second most commonly used way of producing cloth. Knitted fabric has significant technical advantage over woven in terms of production speed. Because of its great adaptability to evolving fashion trends it finds growing acceptance in the industry. Knitting is a flexible technique that can make fabrics with different properties, such as wrinkle-resistance, stretching capacity, better fit, particularly necessary due to the growing popularity of sportswear and casual wear. Weft knit structures such as single jersey, thread, and interlock are most commonly used in knitting industry for the creation of garments. At different stages of relaxation, fabrics are tested for certain dimensional properties in order to assess the suitability of the fibers as raw material for knitted products. The performance of the fabric properties includes geometric, dimensional and mechanical characteristics
Keywords: Abrasion resistance, Bamboo, Bursting Strength, Drape, Interlock, Knitting, Modal, Rib, Viscose

I. INTRODUCTION

A textile is a versatile substance that is heavily influenced by its own weight, which creates significant deflections. Besides weaving, knitting is the second most frequently used method of fabric construction. The popularity of knitting has increased tremendously in recent years due to the increased flexibility of techniques, the adaptability of many modern man-made fabrics and the demand of customers for wrinkle-free, stretch-free, snug fitting fabrics. The analysis is made to evaluate the physical and the dimensional properties of various knit structures which are knitted before sourcing of regenerated fibers. The regenerated fibers so selected are bamboo cotton modal and Viscose. The yarns are sourced of 40^S count and are subjected to knitting in weft knitting machines of prescribed loop lengths. The knitted fabric are treated through various wet processing stages such as dyeing and processing .The performance of the fabric is evaluated through testing in order to determine whether the fabric should be used for the required end use. The Physical properties are the static physical dimensions of the fabric. The physical properties are used to define the static physical dimensions of the Knitted fabrics. The dimensional properties of the knitted fabrics show difference in their characteristics at various stages. The Physical characteristics of the fabric physical characteristics are dynamic physical parameters of the fabric. They are physical changes in the fabric that result from the application of external forces to the fabric. Most of the durability and utility values of the fabric are characteristics, not properties. There are four major categories of fabric characteristics that are of interest to the clothing manufacturer. They're Style characteristics, Utility characteristics
Durability characteristics, Product production characteristics. An attempt has been made to produce knitted fabric with different loop lengths and to compare its geometric and dimensional properties at different processing stages. The main objectives of the study are:

A. Selecting three different bamboo cotton, modal and viscose cellulose yarns with 40s Ne counts.
B. Fabrication of weft knit fabrics of 1x1 rib and interlocks structures with same loop lengths.
C. Preparing, dyeing and fully relaxing 1x1 rib and interlock structures with same loop lengths.
D. Assessing the geometric and dimensional properties of weft knit fabrics through a subjective and objective examination.

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II. MATERIALS AND METHODS

As the main objectives of the study were to produce two different weft structures using three types of cellulose yarns, such as 50-50 bamboo cotton, 100 per cent modal and 100 per cent viscose yarns with a 40-year count. Yarn is a continuous form of twisted fibers of natural or synthetic material, such as wool or nylon, used in weaving or knitting. For this reason, three different 40s count yarns have been selected for the production of different knit structures. All three yarns, bamboo cotton, modal and viscose yarns were available in bleached form purchased from the local market.

Weft knitting and warp knitting are the main forms of knitting technology. In weft knitting, threads running at the right angle to the selvedge and threads running parallel to the selvedge are called warp knitting. Among these methods of knitting, weft knitting has a wide range of clothing applications. The study is conducted by selecting the weft knitting to produce the fabrics.

Various knitted structures, 1x1 ribs and interlocks with the same 0.31 loop length were selected for the study. The fabrics knitted with the same length of the loop vary in the size of the fabric with the 40s yarn count. Loosely knitted fabrics are easily extensible and distorted; while tightly knitted fabrics are more staple and less susceptible to distortion. The dimensions of the fabric depends on the tightness factor

Table 1-Weft knitting Machine Details

Knitting machine	1x1 rib	Interlock
Company name	Mayer &Cie	Mayer &Cie
Make, year	Germany 2004	Germany 2004
Gauge	18	24
Diameter	30 inch	30 inch
Speed	18rpm	18rpm
No. of needles	1680 needles	2,556 needles
No. of feeders	72	96

Table-1 Knitting Machine Details

Weft knitted fabrics, knitted in tabular form, were laid free of restrictions for 24 hours on a flat surface to relax in a dry state at a standard atmosphere of 25+/-20c with a relative humidity of 65+/-2 % As a preparatory step for the removal of foreign matter, the weft knitted fabrics were prepared using liquor The measured amount of sodium hydroxide, sodium silicate was taken and wetted with a wetting agent followed by hydrogen peroxide water was added as per the liquor ration of the material, the temperature was maintained at 60 ^{o}C and maintained for 1 hour.

In order to achieve a fully relaxed state, wet, relaxed samples are further subjected to full relaxation. This was achieved by soaking the fabric samples at 400c for 24 hours.

Physical properties, such as fabric weight and thickness, have been assessed for weft and knitted samples of dry, wet and fully relaxed conditions. Ten samples were cut from different locations; measurements were taken and mean values were calculated. Pre-conditioned weft knitted fabrics samples were evaluated to determine geometrical properties such as loop length, tightness factor, course per centimeter, Wales per centimeter and stitch density.

A. Bursting Strength

The bursting can be achieved with the aid of the Bursting Strength Tester – that consists of a rubber diaphragm. As per British standards, the bursting test may be performed by clamping the fabrics over the rubber diaphragm with the aid of an annular clamping ring and by providing continuous fluid / glycerin pressure. This cycle starts by applying pressure from the underside of the diaphragm. The strength at which the fabric bursts are determined by the analogous or digital meter on the machine. The pressure applied to burst the knitted fabric is noted

B. Abrasion Resistance

The abrasion resistance of the fabric is tested using a Martindale abrasion tester. Samples with a diameter of 38 mm are subjected to an abrasion tester. The test is conducted at each point with 10 samples each. The weight loss of the samples gives the abraded weight from which the mean is measured.

C. Stiffness

The stiffness of the fabric is measured by the MAG stiffness tester, which has a template of 2.5 cm in width and 20 cm in length. The principle behind this is the cantilever principle. The 10 samples of the three stages are subjected to the typical test atmosphere and the stiffness values are determined using the bending length $C = lF(\theta)$

D. Drape

Drape is the tendency of a fabric to slip under its own weight into wave folds of a different type. Fabric drape can be measured both critically and subjectively. Fabric drape can be analyzed through objective measurement, and this is achieved with a drape meter. The drape is expressed in the coefficient of drape and the number of nodes. The sample size is 10 inch cut using template. The ammonia drape meter is used with the solvent placing at the bottom compartment and ammonia sheet for the trace of drape. The drape coefficient is the ratio between the projected area of the draped specimen and its undraped area after the deduction of the supporting disc $F=W_s-W_d/W_D-A_d$

III. RESULTS AND DISCUSSIONS

The selected Bamboo cotton, Modal and viscose yarns of the 40s count are subjected to different yarn test processes in accordance with the ASTM standards. The knitted fabric is subject to different physical and dimensional properties. Physical properties such as bursting strength, abrasion resistance, and drape. Dimensional characteristics, such as the length loop, Wales per inch, courses per inch, the strength factor, are determined. The yarns for knitting are also subjected to a variety of tests, such as strength, elongation, hairiness, imperfections, evenness and count.

Yarn physical properties

S.No	Yarn Particulars	Bamboo Cotton (50 : 50)	Modal (100%)	Viscose (100%)
1	Yarn Count (Ne)	39.6	39.3	39.3
2	Count CV%	1.6	2.1	1.1
3	TPM	890.94	856.69	846.85
4	RKM (g/tex)	12.03	22.71	14.98
5	Mean Elongation	5.83	9.10	11.75
6	CV% of Elongation	15.82	9.17	9.39
7	Mean U%	11.54	10.61	10.34
8	Mean CV%	14.61	13.42	13.02
9	Thin Places (-50%)	8.0	1.0	3.6
10	Thick Places (-50%)	96.0	29.0	11.4
11	Neps/Km (+200%)	68.0	107.0	48.8
12	Total Imperfections/Km	172.0	137.0	63.8
13	YQI	6.07	19.47	17.02
14	Yarn Hairiness	5.82	5.70	5.58

Table-2: Physical Characteristics of Sample Yarn

The loop length of the knitted machine is ready to be 0.31 and therefore the fabric of rib and interlock are constructed the tightness factor. The tightness factor is calculated by the formula

Tightness factor = v Tex count / Loop length

Tex count = 590.5/count = 590.5/40 = 14.76

Knitted fabric properties

Sample No.	Description of Samples	Sample Code	Loop length (cm)	Tightness Factor (Tex$^{0.5}$ cm^{-1})
1	Bamboo Cotton Rib	BNR	0.31	12
2	Modal Rib	MR		
3	Viscose Rib	VR		
4	Bamboo Cotton Interlock	BNI	0.31	12
5	Modal Interlock	MI		
6	Viscose Interlock	VI		

BNR-Bamboo Cotton Rib, BNI-Bamboo Cotton Inerlock MR-Modal Rib , MI Modal Inerlock VR-Viscose Rib VI-Viscose Inerlock

Table 3- Properties of Knitted fabric

The dimensional stability of the knitted fabric is expressed in the ability of the products made from them to preserve the shape and dimensions within the defined limits, it may get affected in its properties due to different treatments and changes

Fabric dimensional properties at fully relaxed stage

S.No.	Samples	Loop Length (cm)	Wales Per(inch)	Course Per(inch)	Stitch length (mm)	Thickness (mm)	GSM g/m^2	Tightness Factor (tex $^{0.5}$cm^{-1})
1	BNR	0.31	45	46	1.46	0.25	146	12
2	MR	0.31	48	47	1.41	0.26	135	12
3	VR	0.31	45	48	1.47	0.25	148	12
4	BNI	0.31	46	45	1.45	0.28	150	12
5	MI	0.31	46	46	1.44	0.27	155	12
6	VI	0.31	47	47	1.46	0.27	158	12

Table 4- fabric dimensional properties

The dimensional properties of the fabric are measured in such a way that all samples are comparatively equal to VR and VI has the highest weight among all other samples and the BNI sample has the highest thickness. Such fabrics are exposed to normal atmospheric conditions and are subsequently processed at different stages, such as wet relaxed stage treatment with other wetting agents.There was a minor improvement in the stitch length thickness and GSM and the tightness factor, but it was definitely very small so that the final stage test results were calculated.

Bursting strength refers to the energy required to split the fabric. When force or pressure is applied vertically to the fabric, it is called bursting. The force needed to split the fabric (when applied perpendicularly) is called bursting power. Extension refers to length transition due to stretching.

Bursting strength of the samples in different stages

Sample No	Sample Code	Bursting Strength		
		Dry Relaxed (kg / cm^2)	Wet Relaxed (kg / cm^2)	Fully Relaxed (kg / cm^2)
1	BNR	2.32	2.26	2.11
2	MR	3.17	3.10	2.82
3	VR	2.96	2.82	2.75
4	BNI	2.82	2.68	2.61
5	MI	4.65	4.44	4.16
6	VI	3.10	3.06	2.80

Table 5- fabric Bursting strength

The bursting strength of the fabric can be used to assess the physical properties and quality of the knitted fabric. It is evident from Table 5 that the bamboo cotton in the wet relaxed stage has the lowest bursting strength and the modal Interlock in the gray stage has the highest strength. The viscose rib and the interlock fabric have a very similar strength range.

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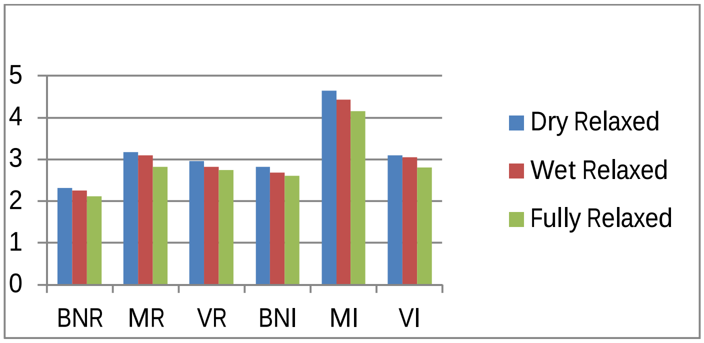
Figure -1 Bursting strength of fabric in various stages



It is evident from the above graph that there is only a small difference in strength compared to all three levels. The modal interlock has the highest bursting strength followed by its rib and viscose interlock. Bamboo cotton has a less bursting strength, which may be due to its blend

The abrasion resistance of the fabric can be defined as the fabric corrosion due to the rubbing against certain rough surfaces. This may be visible in the seat of the garments where the fabrics are subjected to rubbing against certain surfaces. The abrasion is determined by the abrasion tester .The resistance of the fabric to abrade determines the abrasion of the fabric. The samples at all the stages are subjected to abrasion resistance and the result are determined by the difference between the weights of the samples.

Weight loss of fabrics after Abrasion of Weft Knitted Fabrics

Sample No.	Sample Code	Weight loss		
		Dry Relaxed	Wet Relaxed	Fully Relaxed
1	BNR	0.007	0.008	0.009
2	MR	0.009	0.010	0.011
3	VR	0.013	0.014	0.015
10	BNI	0.006	0.007	0.008
11	MI	0.008	0.009	0.010
12	VI	0.011	0.012	0.013

Table 6- fabric Abrasion Resistance

The abrasion resistance of all knitted fabrics is determined, which will also allow us to assess the strength of the fabric due to abrasion. The viscose displays a higher weight loss so that we can conclude that the abrasion resistance is not good compared. Bamboo cotton interlock fabric has a less weightless fabric and is shown to have a stronger abrasion resistance

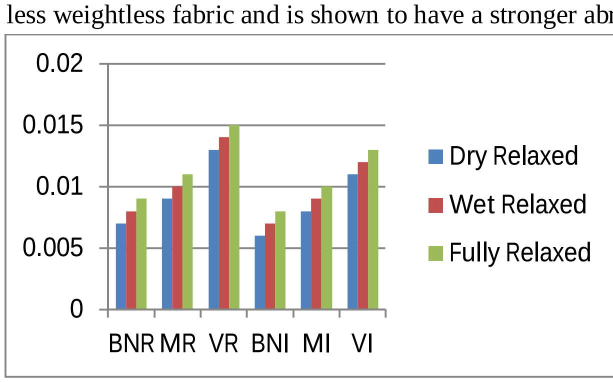


Figure -2 Weight losses due to abrasion at various stages

The abrasion property is measured by the weight loss of the fabric. When it comes to this, it is clear that the viscose rib at the fully relaxed stage has the maximum weight loss followed by its wet and dry stage. The viscose interlock in its three stages also has the maximum weight loss so that we can conclude that the viscose in its rib and interlock has abraded the most. The modal and bamboo cotton have a small difference in abrasion resistance. Compared to bamboo cotton, the weight loss is low.

Stiffness Of Samples In All Stages

Sample No	Sample Code	Mean bending length		
		Dry Relaxed (cms)	Wet Relaxed (cms)	Fully relaxed (cms)
1	BNR	1.54	1.47	1.48
2	MR	1.73	1.8	1.79
3	VR	1.38	1.4	1.46
4	BNI	1.45	1.44	1.47
5	MI	1.68	1.69	1.69
6	VI	1.45	1.46	1.47

Table 6- fabric Stiffness

Table 7-Mean bending length

Stiffness is one of the most commonly used metrics to assess bending stiffness and fabric handling. Fabric stability and handling is an essential decision-making consideration for end users. The degree of stiffness of the fabric is related to its properties, such as fiber content, thread and structure of the cloth. Through this research, the effects of many structural parameters on the stiffness of the fabric have been investigated. The mean bending length is measured by the use of a stiffness tester and the tests differ and indicate a marginal improvement in fabrics at all stages. This is said to have risen after wet treatment and a fully relaxed stage.

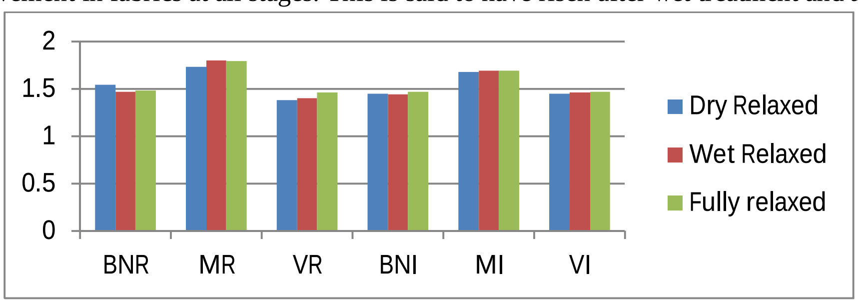


Figure 3 – Fabric Stiffness

The stiffness or mean bending length of the modal rib in its wet, relaxed and fully relaxed stage is high compared to other samples. The viscose rib in the rib structure has a minimum bending length.
A combination of many factors such as stiffness, flexural stiffness, weight, thickness, etc. Stiffness, the characteristic of the cloth side, is one of the most important factors deciding the draping quality of the cloth, e.g. soft tissue drapes closer to the body creating ripples, while stiff tissue drapes away from the body.

Drape coefficient of samples with number of percentage in three stages

Sample No.	Sample Code	Dry Relaxed				Wet Relaxed				Fully Relaxed			
		Face		Back		Face		Back		Face		Back	
		DC%	N	DC %	N	DC%	N	DC %	N	DC %	N	DC%	N
1	BNR	67.9	9.25	67.4	9.5	67.0	9.75	66.5	9.75	57.5	10	63.9	9.7
2	MR	70.8	9.75	68.1	9	55.7	12.25	57.8	13	56.4	12	55.9	11
3	VR	65.9	9	67.2	9	59.8	11.5	57.8	12	54.1	12	55.9	11.5
4	BNI	68.5	8.5	71	8.25	67.5	8.25	68.9	8.25	64.6	9.25	64.1	9.5
5	MI	67.6	8.5	68.8	8.5	56.0	12.25	60.9	10.7	54.3	11.5	54.5	11.7
6	VI	57.8	8.5	64.1	9.5	57.4	11.25	59.9	11.25	54.1	12	55.9	11.5

Table 5- fabric drape and nodes

From the samples checked above, it is noted that the modal rib at the grey stage has a strong drape coefficient with nodes 9.25 on the face side of the cloth. The bamboo cotton interlock fabric has a good drape coefficient at the back with a node of 8.25. The fabric drape with a lower number of nodes has a good drape coefficient.

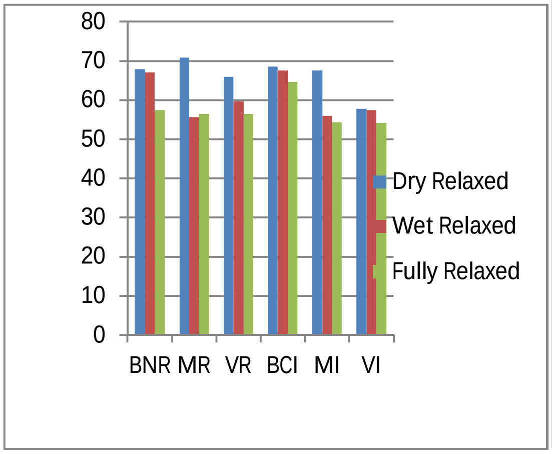


Figure 4- Drape coefficient face side

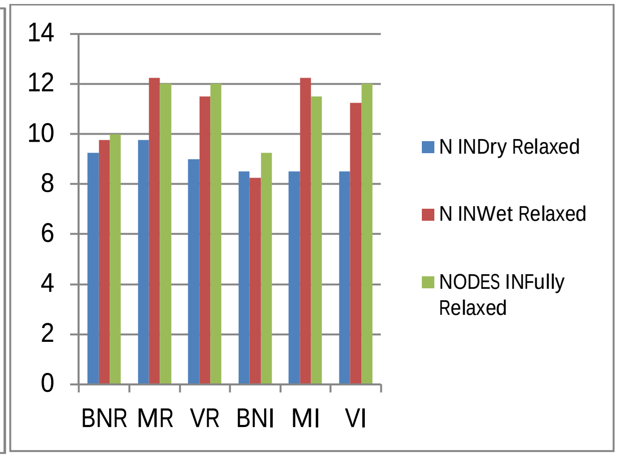


Figure 5- number of nodes at face of fabric

The modal rib fabric has the highest drape coefficient in its dry relaxed state and the number of nodes is lower at the same time that the modal rib in its wet relaxed stage has more nodes but has less drape coefficient. It is seen that the number of nodes is higher but the drape coefficient is lower. The graph gives a simple picture of the drape coefficient of viscose interlock which is the lowest and bamboo cotton has a drape coefficient comparable to modal. That is the side of the fabric on the face and the bamboo cotton has the drape coefficient similar to that of modal. This is the face side of the fabric

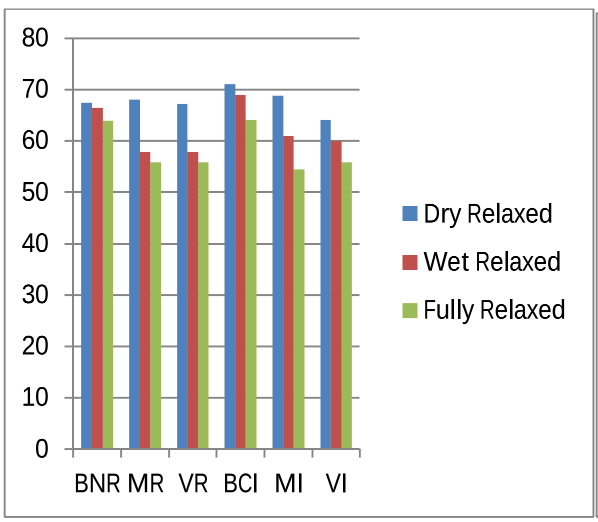


Figure 6- Drape coefficient back side

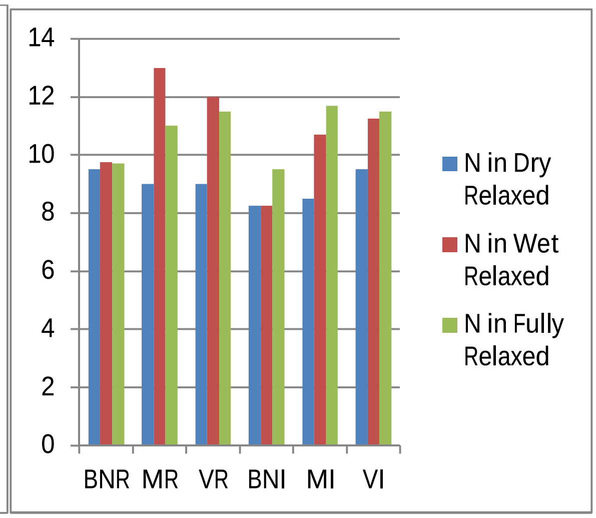


Figure7- number of nodes at back of fabric

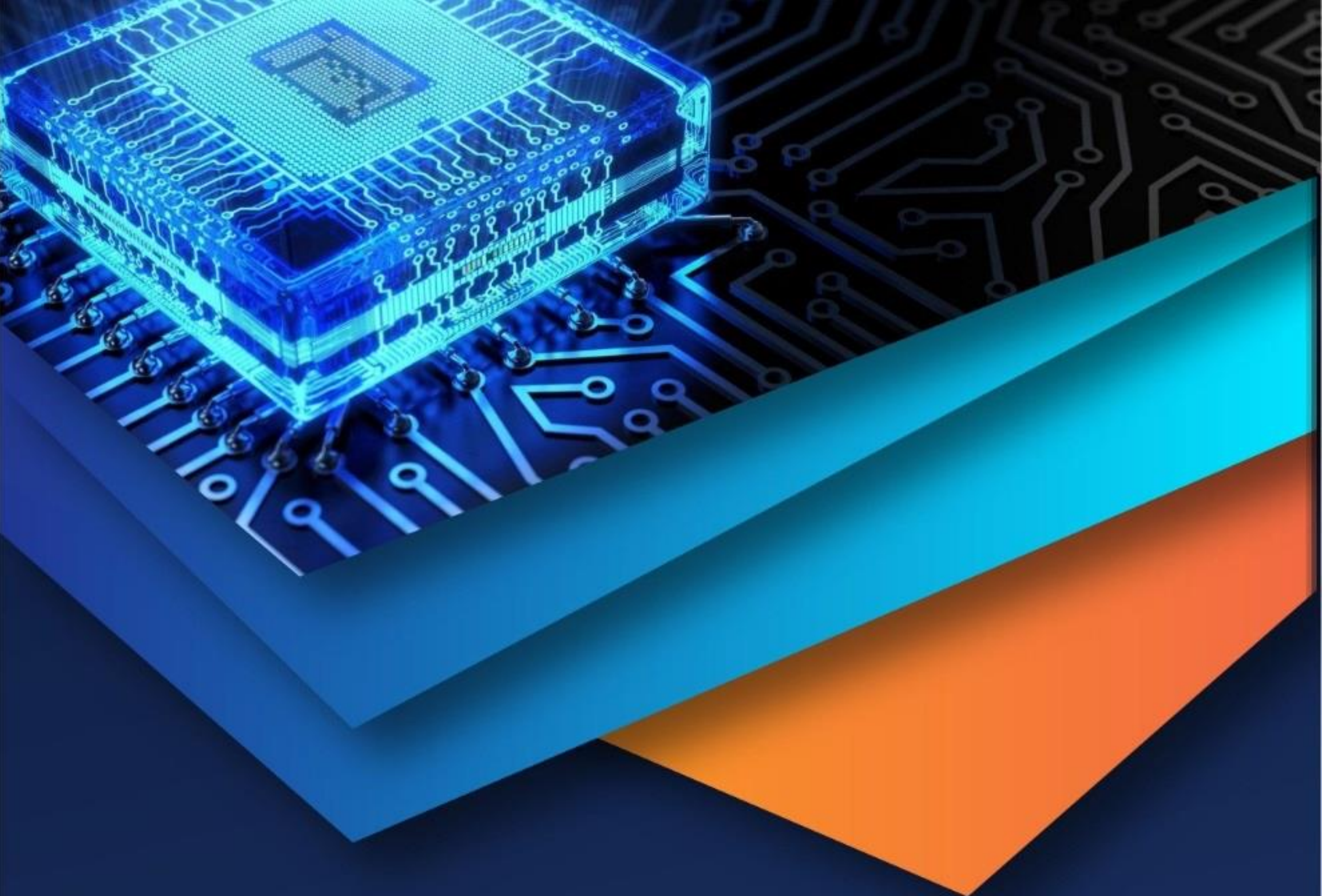
There are only minor differences in the drape coefficient relative to the face and back. In both cases, the number of nodes in the modal rib at the wet relaxed stage is identical**.**

IV. CONCLUSION

The research investigated that the strength and properties of the yarn were associated with the properties of the fabric. The strength of the yarn depends directly on the strength of the fabric, the resistance to abrasion and the drape of the fabric. The interlock made of bamboo cotton has a better grade in all tests carried out, and the other fibers have met the requirement in the same way, though with a small improvement in their properties. The Physical properties and the dimensional properties of the yarn depends on the fabrics property thereby affects the garments characteristics. Thus the physical and Dimensional properties ensures the aesthetic value and quality of the garment

REFERENCES

[1] "Physical Properties." Principles of Textile Testing: an Introduction to Physical Methods of Testing Textile Fibres, Yarns and Fabrics, by John E. Booth, Newnes-Butterworths, 1976.
[2] .Angappan , R.Gopalakrishnan, Textile Testing, 2007,SSMITT pp132-140 305-319 339-343
[3] Griffith, Ross E., et al. *Fibre to Fabric*. McGraw-Hill, 1970, Regenerated fibers PP184-189.
[4] Stephen Eichhorn, J. W. S. Hearle, M Jaffe, T Kikutani. "Regenerated Cellulose." *Handbook of Textile Fiber Structure*, Elseiver Publications, 2009, pp. 201–218.
[5] Al-Gaadi, Bidour, et al. "A New Method in Fabric Drape Measurement and Analysis of the Drape Formation Process." Textile Research Journal, vol. 82, no. 5, 2011, pp. 502–512., doi: 10.1177/0040517511420760.
[6] "Drape ,Abrasion, Yarn Tests, ." Principles of Textile Testing: an Introduction to Physical Methods of Testing Textile Fibres, Yarns and Fabrics, by John E. Booth, Newnes-Butterworths, 1976.
[7] Kenkare, Narahari, and Traci May-Plumlee. "Evaluation of Drape Characteristics in Fabrics." International Journal of Clothing Science and Technology, vol. 17, no. 2, 2005, pp. 109–123., doi:10.1108/09556220510581254.
[8] N. Anbumani., Knitting Fundamentals, Machines, Structures and Developments, 2007,New age publications
[9] nopr.niscair.res.in/bitstream/123456789/2032/1/IJFTR%2033%283%29%20230-238.pdf.
[10] textiles.ncsu.edu/tatm/wp content/uploads/sites/4/2017/11/Plumlee_full_148_05.pdf
[11] http://downloads.hindawi.com/journals/je/2018/8784692.pdf
[12] https://crimsonpublishers.com/tteft/pdf/TTEFT.000506.pdf
[13] https://www.sciencedirect.com/topics/engineering/abrasion-resistance



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