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THE EFFECT OF COTTON YARNS SINGEING AND MERCERIZATION ON THE RATIO OF LIGHT REFLECTION OF THE FABRICS

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ABSTRACT

Although there are many processes for the preparation of yarns and fabrics, it is necessary to determine the type of preparation to obtain the desired properties of these yarns and fabrics as these preparations affect the surface of the yarn and thus affect the surface of the fabric. In this study, preparations of the yarns were applied to change some of the properties and make use of them in the production of fabrics that reflect light using 100% combed cotton yarns and a yarn-singeing process with three speeds of singeing and a mercerizing process with three degrees of concentration of NaOH and then a singeing-mercerization process at the same singeing speeds and degrees of NaOH concentration in order to determine the effect of such preparations for yarn on the percent of light reflection of the fabrics produced. When producing fabrics, the yarns used were those that have been prepared as weft no. 50/2, a fixed number for each preparation and of weaving structure satin 5.Then hairiness ratio was tested before and after the previous preparations and then the ratio of light reflection and k/s for samples of fabrics produced before and after the wefts preparation was measured. The most important findings of the study showed that singeing has given a lower percentage of hairiness of yarns and yarns that contributed directly in increasing the reflection of light by the fabrics and vice versa with low k/s values. The mercerization process has slightly contributed to the low ratio of hairiness and increased the inner surface of the yarn as a result of being swollen thus increasing the surface of the fibers inside the fabrics, decreasing the ratio of light reflection and increasing k/s values. The singeing-mercerization process has led to a decrease in the ratio of hairiness resulting in an increase in the ratio of light reflection and a decrease in k/s from those only mercerized, so the singeing process should be carried out before mercerization.

Keywords**: **Hairiness**, **K/S**, **Mercerization**, **Reflection**, **Singeing

I. INTRODUTION

Light reflection percentage from fabric relies on the properties of yarns used and woven structures [1] Most of the researches were on the properties of yarn and woven structure[2,3]Woven fabrics are made of two sets of yarns, called warps and wefts . Yarns are usually consist of many different kinds of fiber , continuous or staple , parallel or twisted , tightly or loosen . Woven fabrics are classified as to weave or structure according to the

manner in which warp and weft cross each other. The light reflection from fabric relies on that of yarns and the woven structures [3]

Hairiness is an undesirable property of yarn [4] it has always been a matter of concern to improve the yarn quality. in spite of short hairs enhancing the certain aspect of comforts in the fabric, the presence of long hairs is drawback . these affect the appearance of the yarn , and increase the surface friction of the yarn and fabric and form the pilings [5-6] that leads to surface roughness and all of them affects the percentage reflectance [7] hairiness depends on the physical and technological characteristics of raw material , method of spinning preparation and type of spinning system and it can be removed by singeing [8-9] . Hairiness is one of the factors that affects roughness which affected the percentage reflectance [4 , 7] There is another study proved that the weft produced from ring spinning in the fabric has percentage reflectance more than the weft produced from OE rotor-spun in the fabric [10].

Roughness is a measure of the texture of a fabric surface is an important property. A surface can never be perfectly smooth and will always contain two components of surface texture, roughness and waviness. [7, 11-12] The surface may vary between fine and course according to the production process used. Roughness is quantified by the vertical deviation of a surface from its ideal form. If these deviations are large, the surface is rough, if they are small, the surface is smooth. The increase in fiber fineness results from a decrease in fiber diameter and fiber cross-sectional area Fine filament fibre do not absorb all the light rays which center them , and after multiple reflection at the enter filament surfaces some of the incident light is reflected back , a phenomenon described in woven surfaces containing micro fibers as back-scattering [7]

During singeing Singeing is applied on yarn and fabric to remove hairiness on their surface [4,9,13] Treatment, longer hairs might be easily affected by the flam and removes a large amount of hairiness from the yarn , which may affect different properties of the yarn such as appearance , fineness , evenness and tensile properties [4]

Mercerization is an established chemical process for enhancing tensile strength, dye ability and luster of cotton products. a perusal of the literature reveals that many of the previous investigation dealt almost exclusively with the mechanical properties .The relationships between mechanical properties and spinning factors , such as fibre composition , twist factor and draft , have also been studied [14-15] . the pore volume and surface area of cotton fibre play important role in determining the accessibility, sorption ratios and uniformity of reactions involved in dyeing and finishing processes .The pores are interspersed with microfibrillar structure of celluloses and affect the reactivity of celluloses, since they control the accessibility of reagent to the internal sites at which either chemical reaction or physical adsorption by secondary valence forces can occur [16] The size of pores is easily affected by intracrystalline swelling agents , like strong NaOH solutions used during mercerization . the extent of changes occurred depends on the processing time, caustic concentration ,temperature , degree of polymerization, source of cellulose , slack or tension treatment , degree of applied tension during the treatment and physical state of cellulose [17-18] The yarn structural variants considerably influence the reduction in both short and long hairs through mercerization [14] This research is different as it will study the kinds of parathion (singeing , mercerization and both of them together) of combed yarn from ring spinning in the cotton to know the effect of these preparations on the light reflection of the produced fabric from these. Both singeing and

mercerization will collect the properties of the singeing yarn and the properties of the mercerized yarn together in one yarn.

II. EXPERIMENTAL

2.1 Preparation of samples

100% cotton wefts were used combed Giza 86 no. 50/2 and three operations were made to them, the process of singeing the hair only at three speeds and the process of singeing-mercerization (singeing the hair + mercerizing) at the same speeds of singeing and three degrees of concentration of NaOH, where the singeing process was carried out first and then the process of mercerizing and finally a mercerizing process only at the same degree of NaOH used in the singeing-mercerization process together and then three samples were produced using wefts of each stage and a sample without making any preparations (control) so that the total samples of fabrics produced were ten samples.

2.2 Preparations of Yarn Samples

2.2.1 The Singeing Process

The process of singeing the hair was carried out by passing the yarns on the flames of fire at speeds of 800 m/min , 900 m/min and 1000 m /min and the machine specifications were as follows:

Machine Model : ssm Swiss

Machine speed: 1200 m /min

Gas: 27

Air: 12 bar

2.2.2 The Mercerization Process

The yarns were treated with a solution of NaOH a concentration of 26be -30be- 34be on a German machine geige and under tensile between 124 cm – 138cm

2.2.3 The Singeing- Mercerization Process

Yarns from the singeing stage have been used at the same three speeds and then mercerizing was carried out for the singed yarns by using the same degree of concentrations of NaOH and the same specifications used in the two process:

Singeing speed and degree of NaOH concentration were as follows:

800 m / min + 34be

900 m / min + 30 be

1000 m / min + 26 be

Table 1: Shows the Specifications and Preparations of Weft Yarns

NO	Specification	Kind of preparation	weft count	Twist factor
1	Control		50/2	4,5
2	800 m / min	Singeing		
3	900 m / min			
4	1000 m / min			
5	800 m /min + 34be	Singeing-mercerization		
6	900 m/ min + 30be			
7	1000 m /min+26be			
8	26be	mercerization		
9	30be			
10	34be			

2.3 Preparation of Samples of Fabrics:

Samples of fabrics were produced by the Dobi machine and the machine specifications were as follows:

Kind of machine	air jet -dobi – Japan
Number of healds	20 healds
Number of used healds	5 healds to fabric +2 healds to selvage
Reeding	3 end / dent
Reed count	40 dent / inch
Machine width	345 cm
Fabric width with selvage	295 cm
Machine speed	450 picks / min

2.3.1 The Specifications of Fabrics

Table 2 shows the specifications of the samples of fabrics produced using the previous prepared weft yarn nine of these yarns were produced and only one sample of the yarn before undergoing any preparations. The samples were produced with 60 picks /inch fixed for all samples and fixed warp specifications with 125 end / inch as

total number of yarns and warp no. 80/2 and weaving structure satin 5. The specifications of the fabrics were as follows:

Table 2 : Shows the Specifications of the Production of Samples of Fabrics

No	Specification	Kind of preparation	Weft count	Picks number / inch	Warp count	Warps number/ inch	Weaving structure
1	Control		50/2	60	80/2	125	Satin 5
2	800 m / min	Singeing					
3	900 m / min						
4	1000 m / min						
5	800 m /min + 34 be	Singeing-mercerization					
6	900 m/ min + 30be						
7	1000 m /min+26be						
8	26 be	Mercerization					
9	30 be						
10	34 be						

2.4. Testing and Analysis

Tests were conducted on samples of yarn and fabrics in the laboratory under standard conditions and a temperature of 20 ± 2 ° C and humidity 65 ± 5% according to the US ASTM specifications.

2.4.1. Ratio of Hairiness

Hairiness ratio was measured for the yarns before any preparations and after singeing, and singeing-mercerization processes and mercerization only. The test was carried out on the 1000 meters for each yarn by the device Uster 4 Swiss .

2.4.2 Ratio of Light Reflection and k /s

The ratio of light reflection was tested on the surface of fabrics as well as k/s on the spectrophotometer optimatch 3100 England. The device measures wavelengths of (300-700) nanometer.

III. RESULTING AND DISCUSSION

When using 100% cotton yarns and carry out the preparations on them, this has affected the yarn hairiness ratio as shown in Table 3 and Fig 1. When the ratio of light reflection by the fabrics produced from these yarns was tested it was found that the percentage of hairiness of yarns and the preparations on them had a clear impact on the percentage of reflection and Table 4 shows the results of this test, as well as Fig. 2.3.4

Table 3 : Shows the Results of Testing the Weft Yarns

No	Specification	Kind of preparation	Hairiness %
1	Control		6.90
2	800 m /min	Singeing	3.45
3	900 m/ min		3.59
4	1000 m /min		3.50
5	800 m/min+ 34 be	Singeing-mercerization	3.81
6	900 m/min + 30 be		3.82
7	1000 m/min +26be		3.71
8	26 be	mercerization	5.76
9	30 be		5.68
10	34 be		5.74

3.1 The Effect of Singeing , Singeing-Mercerization and Mercerization on the Hairiness

Table 3 and Fig. 1 show the extent of the three preparations on the ratio of hairiness which depends on the total lengths of the fine hairs in 1 cm of the length of the yarn for a distance of 1000 m and a comparison was made between the results in all preparations and the yarns before subjected to these preparations.

i) In the singeing process, it was found that when yarns passed through the flame at three speeds, the flame singes large parts of the lengths of hairs than on the surface of the yarn and thus the ratio of hairiness becomes less. This process gave the filaments dark yellow color and the differences in the ratio of hairiness at the three speeds is slight because it is not possible for the machine to increase speed differences and that the results of this

preparation recorded lower ratio of hairiness than other preparations and the hairiness ratio of the yarn before subjecting it to preparations.

ii) In the singeing-mercerization process, it was found that the percentage of hairiness have registered a very slight increase where the singeing process has been carried out first leading to the low percentage of hairiness in yarns before entering the mercerization stage did so the mercerization did not make any change as the lengths of hairs on the surface are short due to singeing and swelled as a result of the absorption of NaOH and slightly contracted. The increase in the ratio of hairiness is due to yarn circling from hank to cone where the yarns are exposed to friction during winding process resulting in a slight increase in hairiness and it is found that the difference in results of hairiness between the three speeds of singeing and at the three concentrations of NaOH of mercerizing is slight but all tend to increase hairiness more slightly than singed yarns only.

iii) In the mercerization process only it was found that the results recorded the highest ratio of hairiness for all preparations and less than the yarn that did not receive any preparations, where it entered directly to mercerization so that the NaOH was absorbed under stress but the fine yarns on the surface were free and so they contracted in length resulting in a lower ratio of hairiness but the effect of mercerization alone on hairiness was much less than the effect of singeing alone and it was found that the difference in the ratio of hairiness for the concentration of NaOH at three degrees was slight but they are all work in one direction.

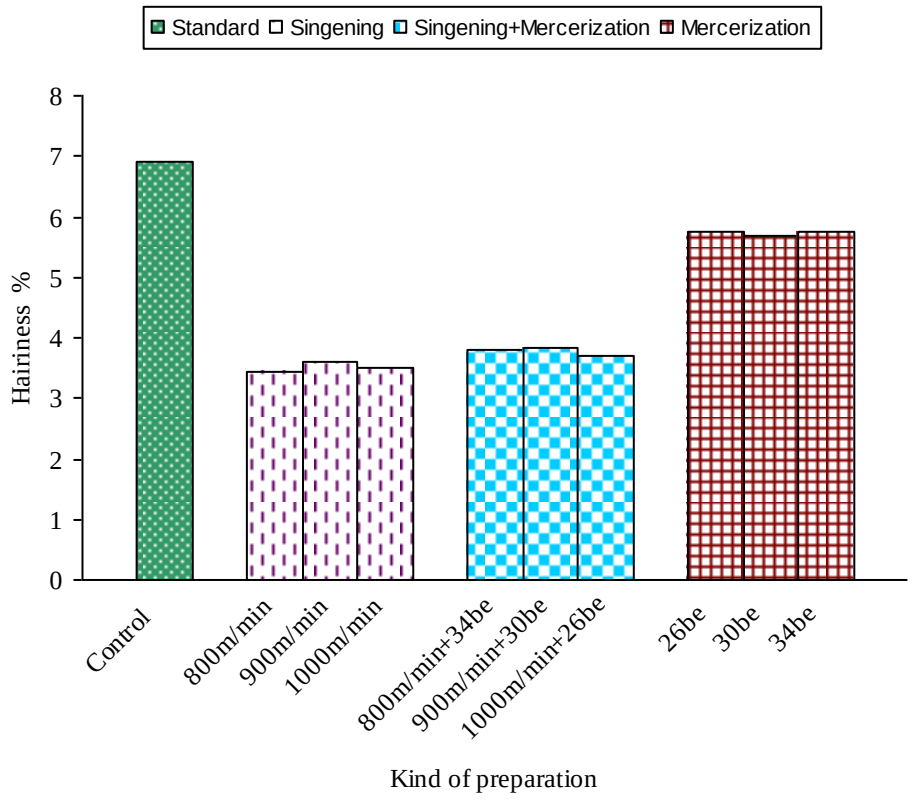

Figure 1 : Shows the effect of different preparations on the ratio of hairiness

Control =Standard= without any preparation

Table 4: Shows the Results of Tests of Reflection Ratio and k/s for the Fabrics at the Wavelength of 700 Nanometer

No	Specification	kind of preparation	Reflection %	k/s
1	Control		77.55	0.0325
2	800 m /min	Singeing	77.54	0.0325
3	900 m/ min		77.88	0.0314
4	1000 m /min		77.95	0.0312
5	800 m / min+ 34be	Singeing-mercerization	76.58	0.0358
6	900 m /min + 30 be		75.61	0.0393
7	1000 m/ min + 26 be		75.69	0.0390
8	26 be	mercerization	72.50	0.0522
9	30 be		75.23	0.0408
10	34 be		70.37	0.0624

3.3. The Effect of Preparation of Yarns and the Ratio of Hairiness on the Reflection of Light on a Fabrics Produced

i) From Table 3 and Fig. 2, 3, 4 we note that both the preparation of singeing yarns recorded higher ratio of the reflection of light on the fabric than the values that recorded by other preparations with the exception of the value recorded by the fabric sample the wefts of which was not subject to any treatment as is evident in Figure 2. The reason for these high values may be due that singeing weft of sample yarns led to the decline of hairiness on the yarns and their fall on the surface of the fabric and the presence of hairiness on the surface of the fabric disperses part of the light falling on the fabric. The less hairiness, the less light dispersed and the more its reflection as described in Fig. 4 It is known that all surfaces which absorb part of the light with different values as a result of the different surface molecules and its thickness. Since the surface of the fabric has pores in-between which allow the entry of an amount of light through them according to the physical equation:

R = 1 - (T + A)

R = the amount of radiation reflected from the fabric

T = the amount of radiation passing through the fabric pores

A = the amount of radiation absorbed by the thickness of the fabric

We note that the K/S recorded by fabrics the wefts of which have undergone singeing have recorded the lowest values than those recorded by the wefts of which have undergone other preparations and the value of K/S refers to the color value which determines the amount of light absorbed by the sample.

In other words, the lower the values of K /S the less absorption of light by the fabric and the highest reflection as shown in Fig. 3 We also note that the reflection of light between the fabric sample that did not receive any preparation and samples the wefts of which have undergone singeing, although the ratio of hairiness was larger for the control sample, was the result of color difference caused by singeing where the color became darker after singeing which led to increasing light absorption and the control sample is lighter in color in all samples.

ii) We note that the treatment of wefts singed and mercerized produced fabrics with less reflection of light than fabrics with wefts singed only as described in Fig. 2 although the ratio hairiness is small a result of singeing the yarns as shown in Fig. 1 This may be due to the fact that the mercerization process had a greater impact because the absorption of NaOH led to swelling of fiber converting the cotton filaments section from the oval shape to the semi-circular shape and this led to an increase in the thickness of the cotton layers and this led to an increase in the thickness of the cotton layers and this led to an increase in the thickness of the cotton layers and an increase of the inner surface and the presence of yarns inside the fabric in Atlas weaving structure which gives the opportunity to have the strings next to each other, thereby increasing the surface which reflects light in produced fabric and this increase in thickness led to an increase in light absorption, dispersion and refraction into the fabric layers where each layer has a different refraction coefficient and this in turn led to the low percentage of light reflection and confirms the increase of k/s values as shown in Fig. 3 which led to a decrease in the ratio of reflection.

iii) We find that the treatment of yarns in mercerization led to an increase in the surface as explained above. In addition, the ratio of hairiness is larger because the yarns were not exposed to singeing and thus the hairy filaments became swollen as a result of absorbing NaOH so the surface area increased in addition to increasing the inner surface of the same yarn, making light absorbed and dispersed twice: the first of at the surface of hairiness located on the surface of the fabric hairs and the second at the surface of the fabric itself so this treatment of yarns recorded the lowest ratio for the reflection of light as shown in Fig. 2 This confirms the high k/s values in this preparation than the other preparations. In other words, the fabrics in this preparation are darker and less reflective of light

. We note that the sample at concentration 30 be recorded a high value of light reflection, but also remain below the results recorded by other preparations. The reason for this may be that the soda concentration did not reach 30 or the yarns did not take enough time for immersion during operation.

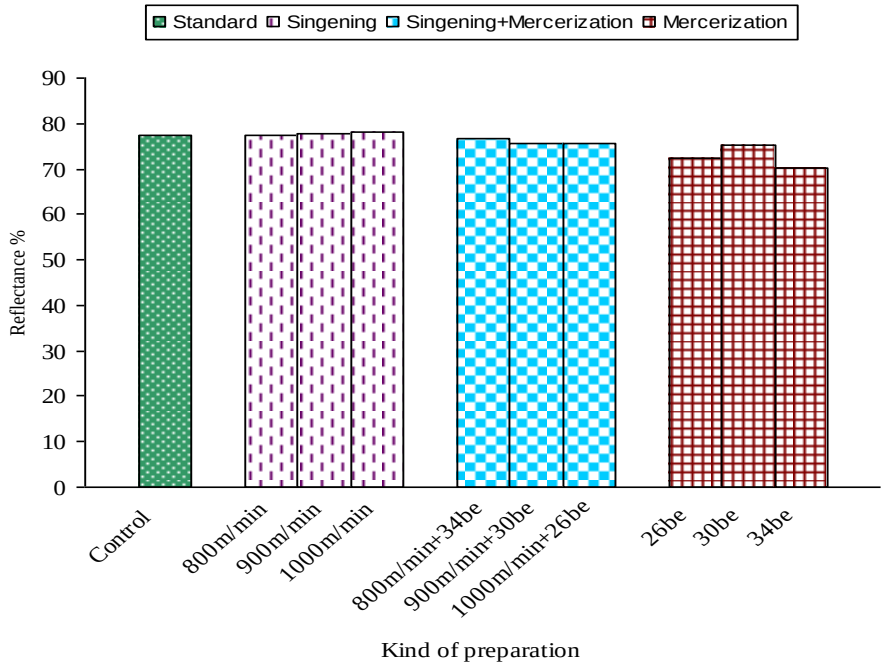

Figure 2 : Shows the effect of Different Preparations on Ratios of Light Reflection for the Produced Fabrics

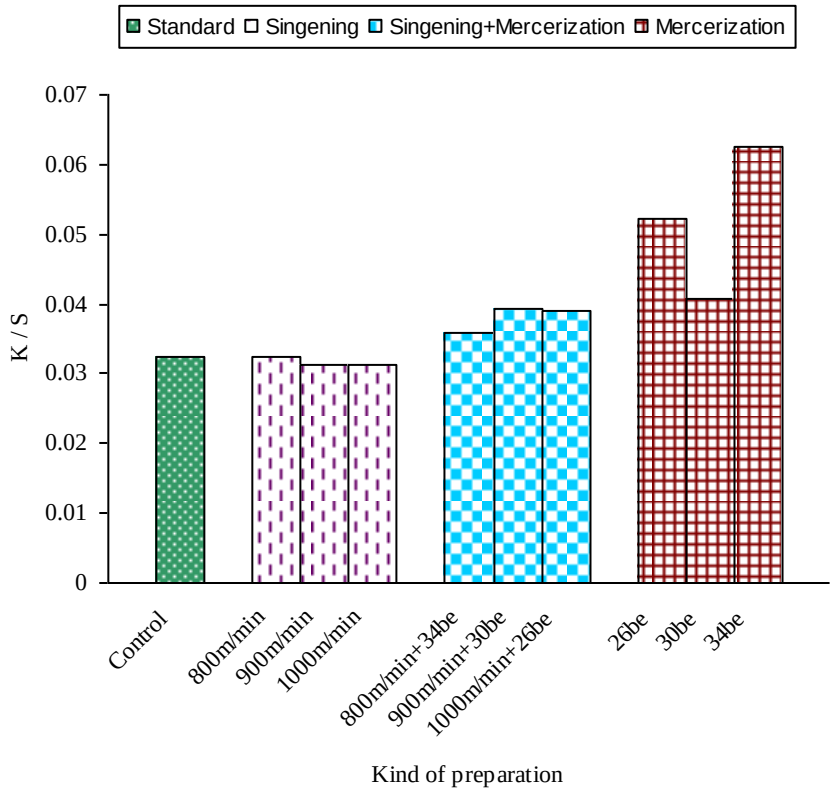

Figure 3: Shows the Effect of Different Preparations of Wefts on k/s Values of the Produced Fabrics

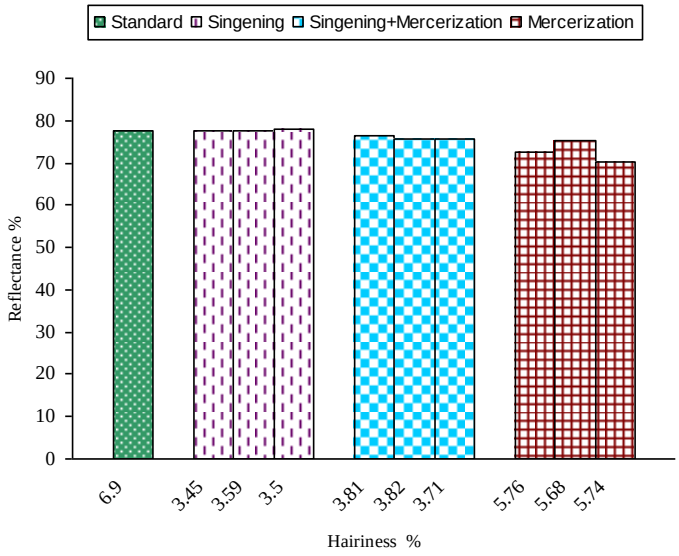

Figure 4 : Shows the Effect of Different Preparations of Weft Yarns on the Ratio of Hairiness

IV. CONCLUSION

The effect of various preparations carried out on wefts had an impact on the ratio of hairiness. In the yarn-singeing process, we find that it led to a decrease of hairiness ratio compared with the ratio of hairiness of the control sample.

In the singeing-mercerization process, it led to a lower ratio of hairiness than the control sample and the mercerized sample and slightly higher than the singed sample as a result of yarn friction when winding process.

In the mercerization process, hairiness ratio has fallen compared with hairiness ratio in the control sample and the sample was higher than the singed and the mercerized.

For samples of fabrics, the wefts coefficients used in fabrics had an impact on the reflection of light by fabrics and values of k/s. The yarn-singeing process led to a slight increase in the ratio of light reflection than the control sample despite the decrease in its hairiness. We find that mercerization process led to a decrease in light reflection and a high ratio of hairiness.

The singeing-mercerization process led to higher light reflection than the mercerized sample only. It preferred to carry out the mercerization process after the singeing to get rid of hairiness and to get a reflection of light higher than for the mercerizing process only.

Increase in the ratio of hairiness led to a lower reflection of light when the surface area of the yarns inside the fabrics was fixed except in the control sample.

The higher the k/s values, the lower the light reflection ratios as a sign of the opacity of fabrics.

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