Faculty of Engineering
Department of Textile Engineering

Comparative study on the effect of silicon based organic polymer as strength improver in finishing of dyed cotton & viscose knitted fabrics

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This Thesis submitted in partial fulfilment of the requirements for the degree of
Bachelor of Science in Textile Engineering

Advance in Wet Processing Technology
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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Ms. Nawshin Farzana, Assistant Professor**, Department of Textile Engineering, Faculty of Engineering, entitled with **"Study on the effect of silicon based organic polymer as strength improver in finishing of dyed cotton & viscose knitted fabrics"** ,Daffodil International University. We also declare that, neither this report nor any part of this has been submitted elsewhere for award of any degree.

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LETTER OF APPROVAL

This project report prepared by **Md. Mizanur Rahman** (ID: 161-23-223), **Soumitra Roy Prince** (ID: 161-23-225), **Imran Hossain Lotus** (ID: 133-23-207) is approved in Partial Fulfilment of the Requirement for the Degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING. The said students have completed their project work under my supervision entitles with **"Study on the effect of silicon based organic polymer as strength improver in finishing of dyed cotton & viscose knitted fabrics"**. During the research period I found them sincere, hardworking and enthusiastic.

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We would like to deliver thanks to our entire course mates in Daffodil International University, who took part in the discussion while completing the course work.

Finally, We would like to express a sense of gratitude to our beloved parents & friends for mental support, strength & assistance throughout writing the project report.

DEDICATION

"This Projects Report is dedicated to our dignified **parents** and **teachers** may they live long"

ABSTRACT

This study is undertaken to know about the Reflectance, Color Strength, Colorimetric value, Bursting Strength, Rubbing fastness and Color Fastness to Wash (Staining & Color change) of 100% Cotton and 100% Viscose fabric. Here we have done Reactive dyeing for 2% (Red) shade and then we apply strength improver finishing agent in both fabric. After we checked sample Reflectance, Color Strength, Colorimetric value, Bursting Strength, Rubbing fastness test and Color Fastness to Wash (Staining & color change) by using Spectrophotometer, Bursting strength, crock meter & Wash fastness tester. After that we calculate Color Strength value by using Kubelka-Munk theory and got better color strength for 100% Viscose fabric than 100% Cotton fabric. After that we calculate Bursting Strength value by using Bursting Strength tester and got better Strength for 100% Viscose fabric than 100% Cotton fabric. After that we have done color fastness test (Rubbing & washing) of the samples and we got the Rubbing fastness property of 100% Viscose is better than 100% Cotton fabric and wash fastness is almost same in both fabric.

Table of Contents

Chapter: 01

Introduction

Cotton: Cotton is a natural cellulosic fiber. Cellulose contain 44% carbon, 6.2% Hydrogen and 49.4% oxygen (1). Cotton_is the world's most popular fiber for textile production (2). A wide range of textile products can be made by using this cotton fibers. To produce heavy or lighter fabric cotton fiber are used. World-wide cotton is most popular because of its less price. The textile products which are made by cotton are suitable for using all the year both in home and industrial uses. Cotton fabric are comfortable to wear because of its high moisture absorbency capability and quick moisture release capability. Generally cotton fiber length ranges from ½ inches to 2 inches and it's moisture regain presentence is 8% and its strength is increase 10 % when it become wet (1). There are many types of cotton fiber found all over the world, they are Asiatic cotton, Egyptian cotton, Canton cotton, Sea Island cotton, American Upland Cotton, Organic Cotton, Pima cotton , French Terry cotton, Bamboo cotton etc. There are many types of finishing process can be done in cotton fabric such as water repellent finish (3), mildew finish, easy care finish, Antiseptic finish, Flame resistant finish etc. Cotton products can be use in both home textiles and garments product.

Viscose: Viscose is a regenerated cellulose fiber which made from natural sources such as wood and agricultural products and viscose is a type of rayon fiber (2). The viscose fiber is used to make different types of textiles for clothing and other purposes. Viscose fiber is also called rayon or viscose rayon. To make viscose fiber at first dissolving wood pulp are regenerating and it form of fibers. The most common raw material for making viscose are Pulp made from wood or bamboo. The molecular structure of natural cellulose is preserved in the process. In viscose yarn

making process the viscose fiber in aqueous solution contain 7-10 % cellulose, 5-7 % sodium hydroxide and about 2-2.5 % bound Sulphur, the rest amount is water and a small amount of impurities (1) . This viscus solution bears the name viscose. 100% viscose looks similar to silk .The mechanical and physical properties of viscose largely depend on the shape of the fiber. Viscose fiber is soft and nice to hand feel, Well-drapable, Antistatic, good at retaining body heat, Non-allergenic and highly durable when dry. Viscose is lighter than cotton and its moisture absorbency twice than cotton.

In this study both fabric are dyed with reactive dye 2%(red) shade . Reactive dyes are more suitable for dyeing cellulosic fiber .This two fabric are dyed with even shade and reactive dye have very good attraction for cellulosic fiber and regenerated cellulosic fibers (4). In reactive dyeing the reactive group of reactive dye react with hydroxyl group of cellulose fiber (5). After dying of both fabric silicon based organic polymer which commercial name is Ludox PE40 is applied in both fabric in a same concentration as a strength improver. Silicon based organic polymer (strength improver) improve the strength of the cellulosic fiber by increasing the crystalline region of the fiber. That means strength improver finishing agent makes the fiber more parallel than before that's why the strength improve. Strength improver also change the colorimetric value of the textile material.

There are many reacharch is done in cotton and viscose fabric with different finishing agent. In this study we apply same quantity of strength improver finishing agent in both cotton and viscose fabric and investigated the physical strength change also investigated colorematric value and fastness properties (wash & rubbing). In the study we compare viscose and cotton fabric strength and colorematric value after applying silicon based organic polymer as strength improver,which is not done enough in reacharch .That's why we are interested to do this work.

1.1: Research objective:

- **Spectral analysis**: Comparative Study on Spectral value of 100% Cotton & 100% Viscose (Finished & Non- Finished) fabric dyed with reactive dye at 2% (Red) Shade.

- **Strength test:** Comparative study on Physical Strength of 100% Cotton & 100% Viscose (Finished & Non- Finished) fabric dyed with reactive dye at 2% (Red) Shade.

- **Color Fastness to rubbing test:** Comparative Study on Fastness property (Rubbing) of 100% Cotton & 100% Viscose (Finished & Non- Finished) fabric dyed with reactive dye at 2% (Red) Shade.

- **Color Fastness to wash test:** Comparative Study on Fastness property (Wash) of 100% Cotton & 100% Viscose (Finished & Non- Finished) fabric dyed with reactive dye at 2% (Red) Shade.

Chapter: 02

Literature Review

Author: **Kawser Parveen Chowdhury** (3): work for water repellant finish in 100% cotton fabric with fluorocarbon based water repellent chemicals .After applying finishing agent she conducted different test like air permeability, bursting strength, color fastness to wash and rubbing. After investigation the result show that after applying finishing agent the air permeability is decrease in the 100% cotton knitted fabric. Bursting strength also decrease after applying water repellant finishing agent and strength is increase if the concentration of finishing material increase. In wash fastness test fastness property improved after applying finishing agent. On the other hand in rubbing fastness after applying water repellant finish both dry & wet rub are increased.

Author: **Ismail Hossain[a], Altab Hossian[a,*], I.A. Choudhury[a], A. Bakar[a] , H. Uddin[b], A.Shahid[c]** (6)**:** Work for color fastness to wash in reactive dyed viscose fabric. They conducted the test the bath volume was 150 ml, ECE Detergent 4g/l, Sodium perborate 1g/l, Time 30 min. , Steel balls 10, Washing temperature was 40^0 c & dyed specimen was 10cm×4cm.They developed fuzzy logic expert modal to investigated the color fastness to wash in dyed viscose fabric. After comparing the conventional method & fuzzy logic expert modal, they get the better & specific color fastness result in fuzzy logic system. In the study they predict color fastness of

viscose dyed fabric in different function of dyeing time, alkali concentration & washing temperature.

Author: **Md. Zahid Hasan** (7): work for dyeing viscose rayon fabric with reactive dye in different temperature. In the study he conducted different test like color fastness to wash, perspiration, rubbing, bursting strength, color strength in different temperature same dyed sample. In those study he found there is no significant change of color fastness to wash properties due to different temperature, temperature affect the color fastness to perspiration properties & rubbing properties. Also when the dyeing temperature increase the strength of viscose rayon fabric decrease & color strength (K/S) value increase.

Author: **Dabasree paul[1,4], Subrata Chandra Das[2,4], Tarikul Islam[3], Md. Abu Bakar Siddiquee[4],Md.Abdullah Al Mamun[4]** (8): work for dyeing cotton fabric with reactive dye in different temperature. In the study they investigated the effect of temperature in color strength, color fastness to wash & rubbing. They found the color strength (K/S) decrease when the temperature lower than 60^0C & higher than 60^0C.The highest value of color strength is obtain in 60^0C temperature. The temperature (60-80)^{0}C the color fastness to wash are good to excellent but in 60^0C dyed sample shows the color fastness to wash both in staining & color change are excellent also the rubbing fastness properties is excellent in 60^0C temperature.

Author: **V.Prasad, A.Arputharaj, A.K Bharimalla, P.G Patil, N.Vigneshwaran** (9): they work for durable multifunctional finishing of cotton fabrics by in situ synthesis of Nano-zinc oxide. They apply anti-bacterial & UV protection finishes by spraying or dipping process. After applying the finishing agent the material shows excellent anti-bacterial activities even after 50 work cycle in both process. Also minimum ultraviolet protection factor work excellent & minimum accepted 50 till 50 wash cycle. Hence spring process up take 3 times less Nano-zinc oxide than dipping process.

Author: MS.A.BAGUM (10): work for different silicon finish like macro, micro and Nano silicon apply in 100% cotton knitted fabric which dyeing with blue and red color. After applying finishing agent she investigated the effect of macro, micro and Nano silicon emulsion softener on color change, color strength, rubbing fastness and different physical properties like drap ability, bending length, absorbency etc. In the study she apply different quantity of finishing agent 10g/l, 20g/l and 30g/l solution in each sample and apply the finishing material in fabric by padding method. The pick-up % of the silicon softener is 80% in the fabric and the drying temperature was 130^0C.After applying silicon emulsion finishing with different quantity there is insignificant color change but Nano silicon color change is less than two other finishing agent. In rubbing fastness test all the finishing agent show almost same rubbing but Nano silicon reduced the wet rubbing fastness and macro silicon improved the wet rubbing fastness. On the other hand Nano silicon provide best absorbency in both fabrics and macro silicon provide little water repellant & make both colored fabric very soft.

2.2-Theoretical Background

2.2.1-Cotton:

The fiber is Cotton is a delicate, soft staple fiber that develops in a boll, or defensive case, around the seeds of the cotton plants of the variety Gossypium in the mallow family Malvaceae. The fiber is practically unadulterated cellulose. Under regular conditions, the cotton bolls will build the dispersal of the seeds.

The plant is a bush local to tropical and subtropical areas around the globe, including the Americas, Africa, Egypt and India. The best decent variety of wild cotton species is found in Mexico, trailed by Australia and Africa. Cotton was freely trained in the Old and New Worlds. Frequently spun into yarn or string and used to make a delicate, breathable material. The utilization of cotton for texture is known to date to ancient occasions; parts of cotton texture dated to the fifth thousand years BCE have been found in the Indus Valley Civilization, just as texture leftovers dated back to 6000 BCE in Peru (11). Albeit developed since vestige, it was the innovation of the cotton gin that brought down the expense of creation that prompted its across the board use, and it is the most generally utilized common fiber fabric in garments today.

Current assessments for world creation are around 25 million tons or 110 million bunches yearly, representing 2.5% of the world's arable land. China is the world's biggest maker of cotton, however the majority of this is utilized locally. The United States has been the biggest exporter for some years. (11)

2.2.1.1-Physical properties of Cotton (5):

Parameter	Evaluation
Specific gravity	1.54
Moisture regain %	8.5
Tenacity (g/denier) dry	3.2
Tensile strength (lb/in^2)	40,000-1,20,000
Elastic recovery	74 at 2% extension
Softening point	60^0C
Melting point	240^0C
Flammability	Burns readily

2.2.1.2-Chemical Properties of Cotton (1)

Parameter	Evaluation
Resistance to strong acid	Poor
Resistance to strong alkali	Excellent
Resistance to mildew	Poor
Effect of organic agent	Poor
Effect of sunlight	Loss of strength

2.2.1.3-Chemical composition of cotton:

The substance organization of cotton fiber comprises of ninety-four percent cellulose, one point three percent protein, one point two percent debris, point six percent wax, point three percent sugar, and 0.8 percent natural acids, and other mixture worsens that make up one point seven percent. The non-cellulose synthetic mixtures of cotton are generally situated in the fingernail skin of the fiber.

The non-cellulose synthetics of cotton comprise of protein, debris, wax, sugar and natural acids (12). Cotton wax is found on the external surface of the fiber. The more wax found on cotton the more prominent the surface region of cotton there is; better cotton by and large has more cotton wax . Cotton wax is fundamentally long chains of unsaturated fats and alcohols. The cotton wax fills in as a defensive hindrance for the cotton fiber. Sugar makes up point three percent of the cotton fiber, the sugar originates from two sources plant sugar and sugar from bugs. The plant sugars happen from the development procedure of the cotton plant.

The non-cellulose chemicals of cotton are detached by using different solvents. Some of these solvents are: hexane, chloroform, sodium hydroxide solutions, non-polar solvents, hot ethanol, and plain water. After scouring & bleaching the cellulose % increase 99% (5).

Cellulose	94%
Organic acid	0.8%
Sugar	0.3%
Wax	0.6%
Ash	1.2%
Protein	1.3%
Other chemical compound	1.7%

2.2.2-Viscose:

Viscose is a regenerated cellulose fiber which produced using regular sources, for example, wood and agrarian items and thick is a sort of rayon fiber. The thick fiber is utilized to make various kinds of materials for garments and different purposes. Viscose fiber is likewise called rayon or thick rayon. To make thick fiber from the start dissolving wood mash are recovering and it type of strands. The most widely recognized crude material for making viscose are Pulp produced using wood or bamboo. The atomic structure of regular cellulose is protected all the while. In viscose yarn making process the thick fiber in fluid arrangement contain 7-10 % cellulose, 5-7 % sodium hydroxide and around 2-2.5 % bound Sulfur, the rest sum is water and a modest quantity of contaminations (1). This viscus arrangement bears the name thick. 100% viscose appears to be like silk .The mechanical and physical properties of thick to a great extent rely upon the state of the fiber. Thick fiber is delicate and pleasant to hand feel, Well-drapable, Antistatic, great at holding body heat, Non-allergenic and exceptionally sturdy when dry. Viscose is lighter than cotton and its dampness retentiveness twice than cotton.

2.2.2.1-Viscose manufacture:

Viscose rayon is a fiber of recuperated cellulose; its sub-nuclear structure is that of cellulose in cotton and various plants, for instance, soy, bamboo, and sugar stick. Cellulose is a straight polymer of β-D-glucose units with the observational formula $(C_6H_{10}O_5)_n$. To prepare viscose, dissolving crush is treated with watery sodium hydroxide (typically 16-19% w/w) to outline "salt cellulose", which has the assessed condition $(C_6H_9O_4\text{-Ona})_n$ (2). This is allowed to depolymerize

to a certain extent. The pace of polymerization (maturing or creating) depends upon temperature and is impacted by the closeness of various inorganic included substances, for instance, metal oxides and hydroxides. Air similarly impacts the maturing methodology since oxygen causes depolymerization. The stomach settling agent cellulose is then treated with carbon disulfide to outline sodium cellulose xanthate.

$(C_6H_9O_4\text{-Ona})n + nCS2 \rightarrow (C_6H_9O_4\text{-}OCS_2Na)n$

The higher the extent of cellulose to joined sulfur, the lower the dissolvability of the cellulose xanthate. The xanthate is separated in liquid sodium hydroxide (regularly 2-5% w/w). The game plan's thickness is directed by the level of de-polymerization of the dissolvable base cellulose.

Rayon fiber is conveyed from the matured courses of action by treatment with a mineral destructive, for instance, sulfuric destructive. In this movement, the xanthate bundles are hydrolyzed to recuperate cellulose and release dithiocarbonic destructive that later separates to carbon disulfide and water (2).

$(C_6H_9O_4\text{-}OCS_2Na)2n + nH_2SO_4 \rightarrow (C_6H_9O_4\text{-}OH)2n + 2nCS_2 + nNa_2SO_4$

$H_2COS_2 \rightarrow H_2O + CS_2$

Alongside regenerated cellulose, aging gives hydrogen sulfide (H_2S), sulfur, and carbon disulfide. The string created utilizing the recouped cellulose is washed to remove staying destructive. The sulfur is then cleared by the extension of sodium sulfide plan and pollutions are oxidized by whitening with sodium hypochlorite course of action or hydrogen peroxide solution.

2.2.2.2--Physical Properties of Viscose (5)

Parameter	Evaluation
Specific gravity	1.3
Moisture regain %	11
Tenacity (g/denier) dry	2.5
Tensile strength (lb/in^2)	30,000-45,000
Elastic recovery	60 at 2%
Softening point	150^0 F
Melting point	200^0 F
Flammability	Burns readily

2.2.2.3-Chemical Properties of Viscose

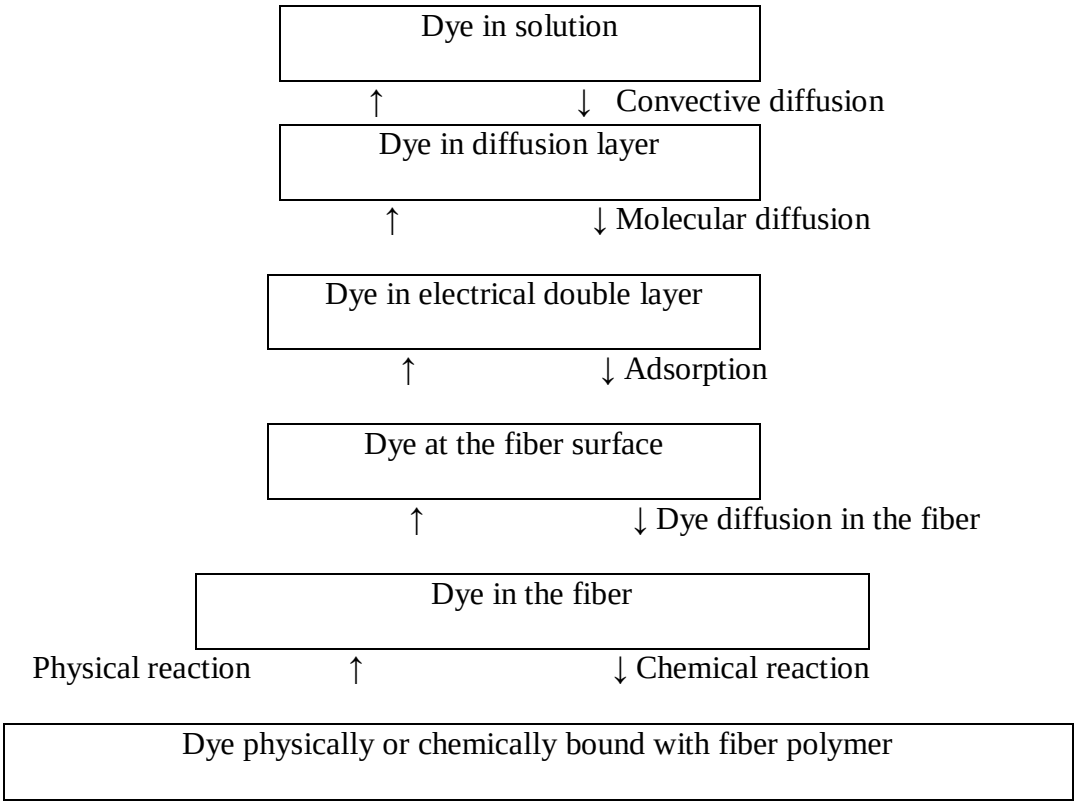
Parameter	Evaluation
Resistance to strong acid	Poor
Resistance to strong alkali	Poor
Resistance to mildew	Resistant
Effect of organic agent	Resistant
Effect of sunlight	Resistant

2.2.3-Reactive dye:

Reactive dye is a dye which have reactive group and the reactive group react with hydroxyl group of cellulose fiber and dyed the fiber. Reactive dyes form covalent bond with cotton through nucleophilic substitution or nucleophilic addition mechanism and the dyes are familiar as substitutive and additive dyes respectively. Due to presence of strong dye–fiber interaction, fastness properties are remarkably good except wash fastness which is poor to moderate due to

hydrolytic nature of dyes. Pre-dissolved dye is applied on cotton; salt is added for better exhaustion followed by fixation with alkali. Subsequent soaping and washing remove all superficial and hydrolyzed dyes (13).

2.2.3.1-Successive stage in the dyeing process:



2.2.4-Computer Color Matching System (CCMS):

CCMS is used to match the two dyed sample shade. Generally buyer gives the swatch fabric sample or Panton number to the producer. Then the producer give the sample to the lab dip development department. After receiving the sample they investigated the color of the sample manually or with the help of CCMS.

At first the sample fit to the spectrophotometer and spectrophotometer analyze the color and gives the result of color dept. At the same time spectrophotometer gives the color combination that means the number of color are used to dye the fabric. Then it gives the dyeing recipe according to the shade depth.

2.2.4.1-Advantages of Computer Color Matching System (CCMS):

1. Customers get the exact shade matching with his knowledge of degree of metamerism.
2. Customers often have a choice of 15-20 formulation that will match color. By taking costing, availability of dyes, and auxiliaries into account, one can choose a best swatch.
3. 30 to 300 times faster than manual color matching.
4. Limited range of stock color needed.

2.2.5-Bursting strength:

Bursting strength is a strength which is checked by applying stressed in all direction of knit fabric. In standard type of bursting strength test an elastic diaphragm is used to load the fabric, the pressure of the fluid which is behind the diaphragm being used as the measure of stress in the fabric. Then the bursting strength is measured in units of pressure. As there is a sizeable power

required just to blow up the diaphragm this must be considered in the test. The typical path is to gauge the expansion in tallness of the diaphragm during the test and afterward to swell the diaphragm to a similar stature without a specimen present. The constrain required to expand the diaphragm alone is then deducted from the weight estimated at the purpose of failure of the sample. The connection between the diaphragm stature and the fabric expansion is very disconcerting with the goal that the technique isn't utilized to acquire an estimation of fabric expansion (14).

There are two method for bursting strength measurement-

1. Diaphragm bursting test
2. Ball bursting test

2.2.5.1-Diaphragm bursting test: It is a British standard bursting strength measurement technique in which the specimen is clamped between two clamps & increasing flued pressure is applied to underside of diaphragm until the specimen burst. The operating fluid either liquid or a gas. In this test two size of specimen are used & they are either 30 mm diameter or 113 mm diameter. The large dia specimen take low pressure in bursting & the specimen burst within 20±3 sec.

2.2.5.2-Ball bursting test: There is no British standard for ball bursting test of knitted fabric. In this test a 25 mm diameter steel ball is used. This ball pushed the specimen & required force is recorded for bursting the specimen.

2.2.6-Rubbing fastness:

Rubbing fastness is an off line quality assurance system. The measurement of rubbing fastness is very important to know the ability of the dyed fabrics against the rubbing or staining. This test measure the dye fixation of the dyed fabric. When rubbing fastness is found good then it also determine that the dyes are fixed very well and the washing fastness of the fabric will be good. There are two method of measuring rubbing fastness, one is dry and other is wet form of the fabric. Crock meter is used to conduct the rubbing test. The rubbing fastness properties of the textile material are dignified by comparing the tested fabrics with the grey scale (15).

Sample:

- Dyed fabric dimension -14 cm x 5 cm
- White Test Cloth -5 cm x 5 cm
- Time(sec) and cycle- 10×10

2.2.6.1-Specification of Crock Meter

Diameter of the Rubbing Finger	16 mm
Force on the Finger	9 N
Size of Crocking cloth	(5×5) cm
Length of the Traverse	100 ± 5 mm
Counter (Re-settable)	4 Digit Counter
Size of Test Specimen	(14×5) cm
Net Weight of the Unit	4 kg (9 lbs)
Construction	Cold-rolled steel

2.2.6.2-Rubbing Fastness Measurement Procedure

The measurement of rubbing fastness property is a step by step process. Rubbing fastness of the material is done in dry and wet form like the following way. .

Dry Rubbing:

• It is important to mount the specimen and test fabrics properly. The counter must be reset by moving the handle on the left half of the counter. The finger is situated on the example at the base's front end and handle is turned the clockwise way at the pace of around 1 transformation for each second. The handle is then pivoted equivalent to the quantity of strokes determined by the test strategy.

• When the ideal number of strokes is come to, the crocking fabric is expelled from the finger and its level of recoloring must be assessed by SDC grey scale.

Wet Rubbing:

- At first a fresh crocking cloth is immersed in distilled water for make the crocking cloth wet.
- Then the crocking cloth is fixed over the finger of the crock meter.
- Then the dyed or printed fabric has to be mounted on a lower platform of the crock meter.
- Then 10 cycles are rubbed with a white fabric, which is mounted on a hanger in the upper rubbing arm.
- After that the white crocking cloth are removed and evaluate the color fastness to rubbing with the help of a grey scale.

2.2.7-Color fastness to wash:

In colorfastness to wash measurement at first a specimen/dyed material in contact with multi fiber fabric is laundered rinsed & dried. Then the specimen/composite sample is treated in a chemical bath with appropriate condition for recommanded time. The abrasive action is accomplished by the use of liquor ratio & appropriate number of steel ball. The color change & staining is assessed by recommended grey scale (14).

2.2.7.1-Test specimen:

The test specimen should be 10 cm × 4cm & sew it with same size multi-fiber fabric.

2.2.7.2-Apparatus & Materials:

- ✓ Wash-wheel with a thermostatically controlled water bath and rating of (40±2) rpm.
- ✓ Stainless steel container (capacity 55±50)
- ✓ Stainless steel ball (dia=.6 cm , weight=1gm)
- ✓ SDC, Multi-fiber
- ✓ Thermometer
- ✓ Sewing m/c
- ✓ Dryer
- ✓ Color matching
- ✓ ISO Scales

ISO Standard for color fastness to wash test:

Test	Temperature (^{0}C)	Time (Minute)	Steel Ball	Chemicals
ISO-105-CO1	40	30	00	Soap (5 g/l)
ISO-105-CO2	50	45	00	Soap (5 g/l)
ISO-105-CO3	60	30	00	Soap (5 g/l)+ soda 2 g/l
ISO-105-CO4	95	30	10	Soap (5 g/l)+ soda 2 g/l
ISO-105-CO5	95	240	10	Soap (5 g/l)+ soda 2 g/l

Chapter: 03

3. Material & Method

3.1: Material:

3.1.1: Fabric Specification:

Industrial Scoured & Bleached samples were collected from Cotton Club (BD.) Ltd.

Parameter	100% Cotton	100% Viscose
Types	S/J Knitting	S/J Knitting
GSM	135	130
Count	38 Ne	39 Ne
WPI	50	48
CPI	40	32

3.1.2: Dyes & Chemicals:

Serial	Chemical Names	Commercial Names
1	Reactive Dye (Red)	Finozol Red K2BF
2	Soda	Caustic Soda
3	Salt	Glauber salt
4	Acetic Acid	n/a

3.1.3: Finishing Agent:

Serial	Chemical Names	Commercial Names
1	Silicone based organic polymer as Strength Improver	Ludox PE 40

3.2: Method:

3.2.1: Dyeing methods (recipe, curve and procedure):

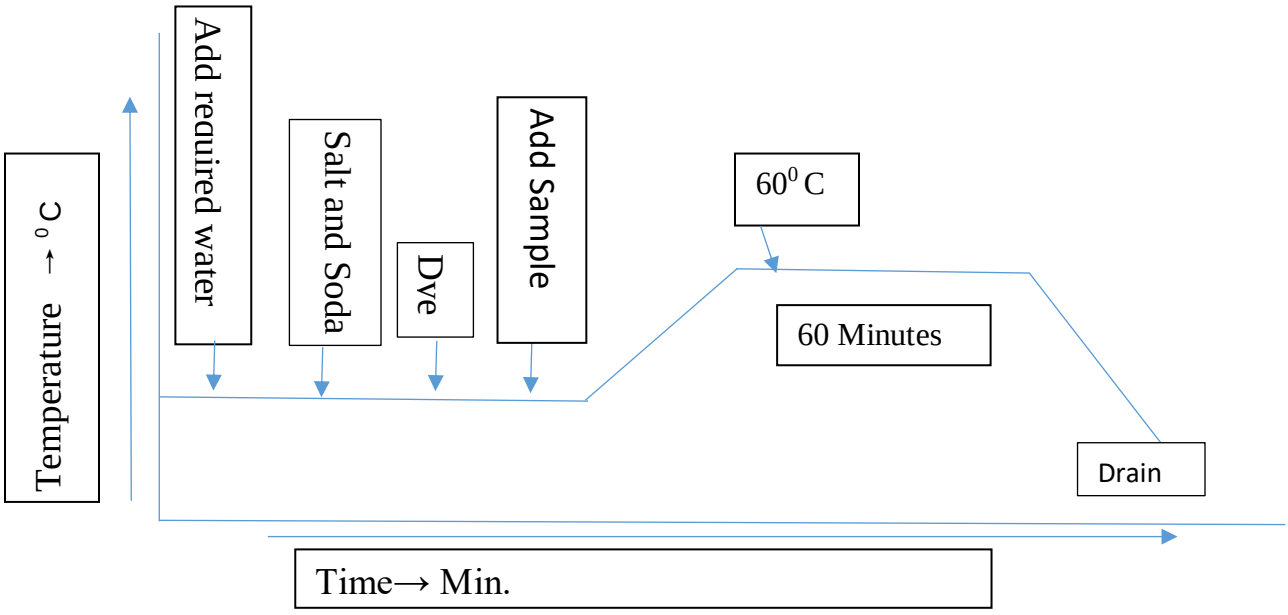
Recipe for dyeing **100% Cotton** fabric by **Reactive dye** for **2% (Red)** shade

Serial	Chemicals	Amounts
1	Finozol Red K2BF	2%
2	Soda	12 g/l
3	Salt	50 g/l
4	Sample Weight	5 gm
5	M:L	1:10
6	pH	11.5

Recipe for dyeing **100% Viscose** fabric by **Reactive dye** for **2% (Red)** shade

Serial	Chemicals	Amounts
1	Finozol Red K2BF	2%
2	Soda	10 g/l
3	Salt	50 g/l
4	Sample Weight	5 gm
5	M:L	1:10
6	pH	11.5

Process Curve:



Dyeing procedure:

100% Cotton and 100% Viscose fabric with **reactive dye** for **2% shade**.

At first we collect the pre-treated 100% Cotton and 100% Viscose sample from the industry lab store.

↓

Then we measure and add the dyes, and chemicals to the pot

↓

Then we add required amount of water

↓

After that we add the sample to the pot with dyes, chemicals & water

↓

Then we seal the pot and we set the pot to the sample dyeing machine and set the machine time and temperature

↓

Then dyed the sample at 60^0 C Temp. for 60 min.

↓

Drain the dye bath

↓

Wash the sample

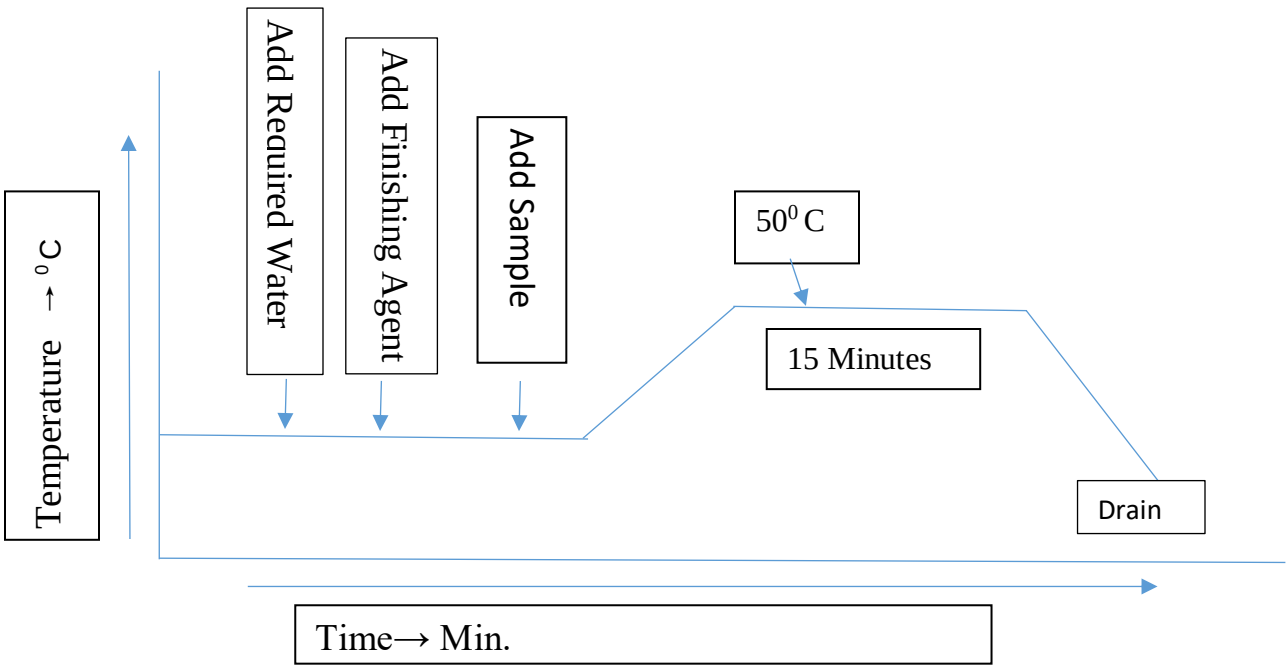
↓

Dry the sample

3.2.2. Finishing method with recipe, curve and procedure:

Serial	Chemicals	Amounts
1	Ludox PE 40(Silicone based organic polymer as Strength Improver)	2% (recommended by the supplier)
2	M : L	1:30
3	Temperature	50^0 C
4	Time	15 Min.
5	pH	5.5

Process Curve:



Procedure:

At first we took the dyed fabric at 100% Cotton and 100% Viscose sample

↓

Then we calculate and add Finishing Agent to the pot

↓

Then we add required amount of water

↓

After that we add the sample to the pot with Finishing Agent & Water

↓

Then we seal the pot and we set the pot to the sample dyeing machine and set the machine time and temperature

↓

Then finished the sample at 50^0 C Temp. for 15 min.

↓

Drain the bath

↓

Wash the sample

↓

Dry the sample

3.2.3. Test Method

3.2.3.1: Spectral analysis

we found the reflectance% values, color strength (K/S), L*, a*, b*, c* values by using spectrophotometer. And we measured the color strength (K/S) values of dyed sample by using equation no (1):

$K/S = (1-R)^2/2R$…….(1)

Here,

R= Reflectance

K=Absorption

S=scattering co-efficient

Change in color strength was calculated by the equation no (2)

$$\textbf{Color Strength Change (\%)} = \frac{\frac{K}{S}(\textbf{before}) - \frac{K}{S}(\textbf{after})}{\frac{K}{S}(\textbf{before})} \times 100 \quad \text{……..(2)}$$

3.2.3.2. Strength test

ISO 13938-2 was obtained to all samples for Strength test. Percentage of strength improved was calculated by the equation no (3)

Bursting Strength Change %

$$= \frac{Strength\ (after\ finishing) - Strength\ (before\ finishing)}{Strength\ (before\ finishing)} \times 100 \quad \text{.....(3)}$$

3.2.3.3. Color Fastness to rubbing test

ISO-105-X12 was obtained to all samples for rubbing test.

3.2.3.4. Color Fastness to wash test

ISO-105-C02 was obtained to wash all the samples.

Chapter: 04

4. Result & Discussion

4.1. Spectral analysis

Reflectance Value of Cotton & Viscose

X (nm)	Cotton		Viscose	
	Y_1 (R%) Before Finishing	Y_2 (R%) After Finishing	Y_1 (R%) Before Finishing	Y_2 (R%) After Finishing
400	16.845	17.193	10.899	11.147
410	17.890	18.236	11.822	11.955
420	18.930	19.380	12.849	12.800
430	19.490	20.117	13.576	13.348
440	18.934	19.596	13.411	13.019
450	16.746	17.319	11.671	11.301
460	13.766	14.177	9.092	8.858
470	10.875	11.108	6.633	6.530
480	8.632	8.767	4.819	4.825
490	7.120	7.193	3.730	3.765
500	5.912	5.952	2.948	2.982
510	5.052	5.054	2.406	2.474
520	4.751	4.754	2.217	2.305
530	4.733	4.749	2,214	2.298
540	4.681	4.671	2.203	2.279
550	4.850	4.829	2.264	2.396
560	6.132	6.106	2.886	3.132
570	9.910	9.989	5.239	5.652
580	17.816	18.270	11.466	11.866
590	29.878	30.988	22.415	22.396
600	43.992	45.889	36.198	35.446
610	57.529	60.292	50.72	49.027
620	68.036	71.470	63.460	61.402
630	74.688	78.375	72.836	70.681
640	78.390	81.992	78.349	76.348
650	80.361	83.853	81.261	79.338
660	81.265	84.820	82.844	80.731
670	81.763	85.402	83.880	81.405
680	82.335	85.987	84.687	82.042
690	83.226	86.637	85.361	83.007
700	84.181	87.116	85.838	84.067

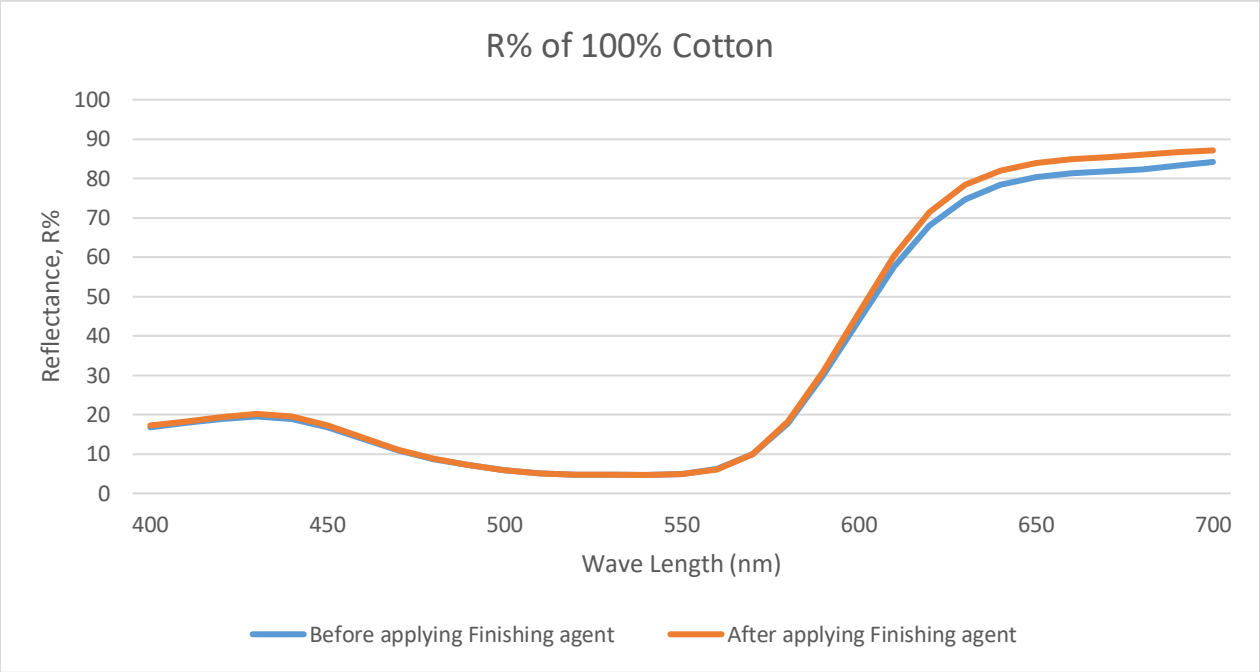


Figure: Reflectance % Curve of 100% Cotton fabric

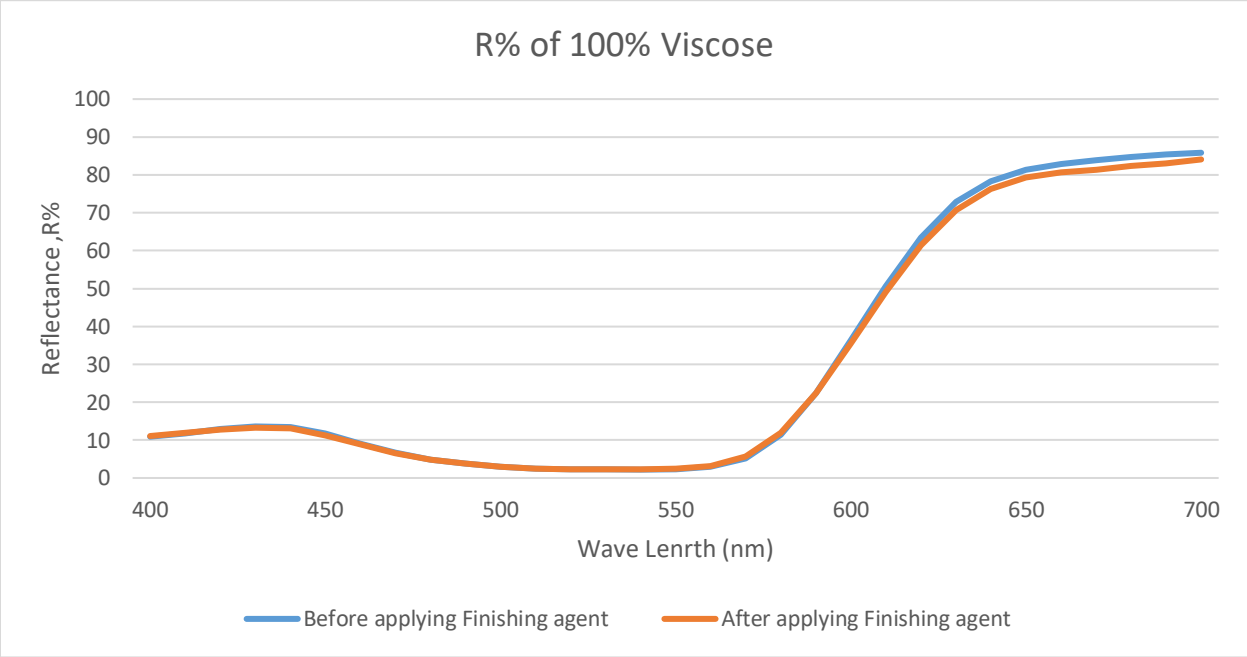


Figure: Reflectance % Curve of 100% Viscose fabric

Reflectance %

R_{min} at 540 nm from reflectance data for 100% cotton and 100% Viscose fabric

Shade %	**100% Cotton R_{min} at 540 nm**		**100% Viscose R_{min} at 540 nm**	
	Before Finishing	After Finishing	Before Finishing	After Finishing
2%	4.681 %	4.671 %	2.203 %	2.279 %

Color Strength

K/S Value for 100% cotton and 100% Viscose fabric

Shade %	**K/S value of 100% Cotton**		**K/S Change %**	**K/S value of 100% Viscose**		**K/S Change %**
	Before Finishing	After Finishing		Before Finishing	After Finishing	
2%	9.70	9.73	0.30 % Increase	21.70	20.95	3.46 % Decrease

Discussion:

We found R_{min} 540nm for both cotton & viscose dyed fabric with 2% (Red) shade. If we compare Cotton we can see that the reflectance value in before finishing sample is more than after finishing sample. And if we compare Viscose fabric we can see that the Reflectance value in after finishing sample is more than before finished sample. We know that reflectance value become more when the shade percentance become lighter & reflectance value become lower when the shade percentance become deeper. So, In this case we can say that in cotton dyed fabric

the shade become deeper after applying finishing agent & in viscose dyed fabric the shade become lighter after applying finishing agent.

There is no remarkable change in color strength in both cotton & viscose fabric after applying finishing agent. But color strength very little increase in cotton fabric & little decrease in viscose fabric after applying finishing agent.

Colorimetric properties

Comparison of colorimetric values of 100% cotton and 100% Viscose fabrics for 2% (Red) shade.

Light Source		**100% Cotton**	**100% Viscose**
D 65	$\Delta L(L_{\text{after finish}} - L_{\text{before finish}})$	0.74 L	-0.22 D
	$\Delta a^* (a_{\text{after finish}} - a_{\text{before finish}})$	1.44 R	-1.21 G
	$\Delta b^* (b_{\text{after finish}} - b_{\text{before finish}})$	0.25 Y	0.26 Y
	$\Delta E=\sqrt{\{(\Delta L)^2 +(\Delta a)^2+(\Delta b)^2\}}$	0.63	0.48

Discussion:

Here for 100% cotton fabric ΔL indicate that the batch fabric become lighter than standard sample. Δa* indicate that the batch fabric become reddish than standard sample. Δb* indicate that the batch fabric become yellowish than standard sample. Color difference ΔE indicate the acceptable value.

And for 100% viscose fabric ΔL indicate that the batch fabric become darker than standard sample. Δa* indicate that the batch fabric become greener than standard sample. Δb* indicate

that the batch fabric become yellowish than standard sample. Color difference ΔE indicate the acceptable value.

4.2. Bursting Strength

Parameter	100% Cotton		Strength Change %	100% Viscose		Strength Change %
	Before Finishing	After Finishing		Before Finishing	After Finishing	
Pressure	289.7 Kpa	318.3 Kpa	9.87 %	339.8 Kpa	398.3 Kpa	17.22 %
Time	16.4 sec.	17.9 sec.		20.9 sec.	22.6 sec.	

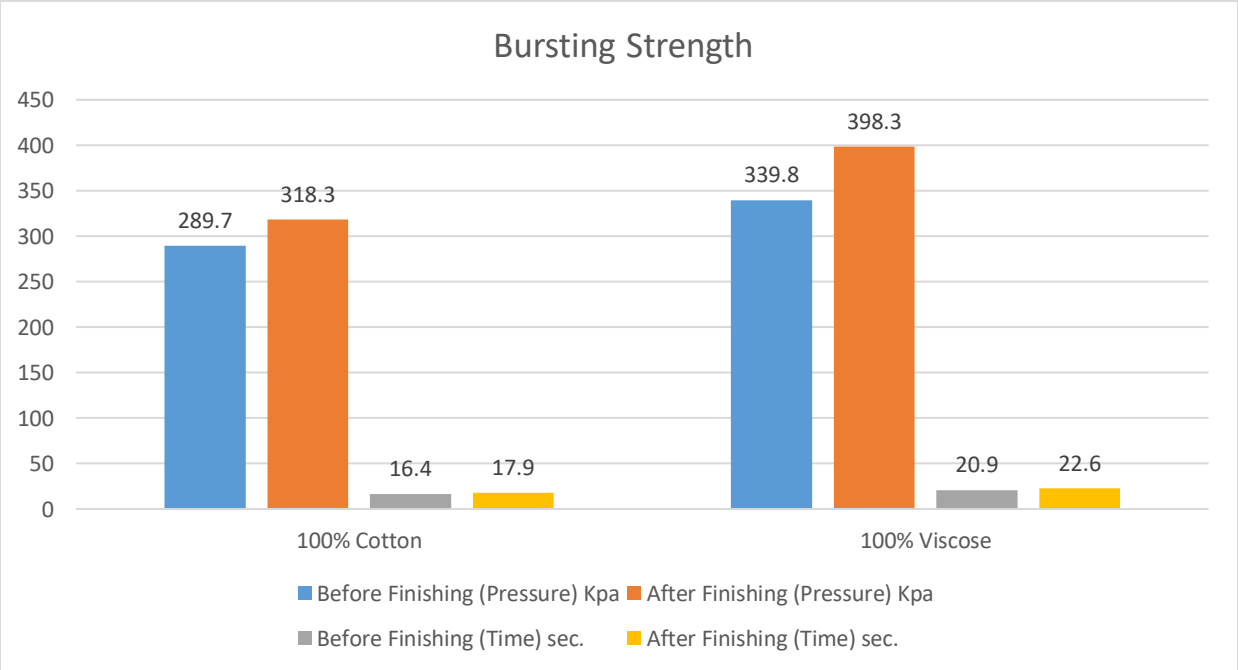


Figure: Bar diagram grade of Bursting Strength result for 100% Cotton & 100% Viscose fabric.

Discussion:

Here we can see that after applying finishing agent the strength of viscose fabric increase more than cotton fabric. So we can say the strength of viscose fabric increase twice than cotton fabric.

4.3: Color fastness to Rubbing Test

For Cotton & Viscose:

sample	Before Finishing		After Finishing	
cotton	**Dry**	**Wet**	**Dry**	**Wet**
	4	3	4/5	3/4
viscose	**Dry**	**Wet**	**Dry**	**Wet**
	4/5	4	4/5	3/4

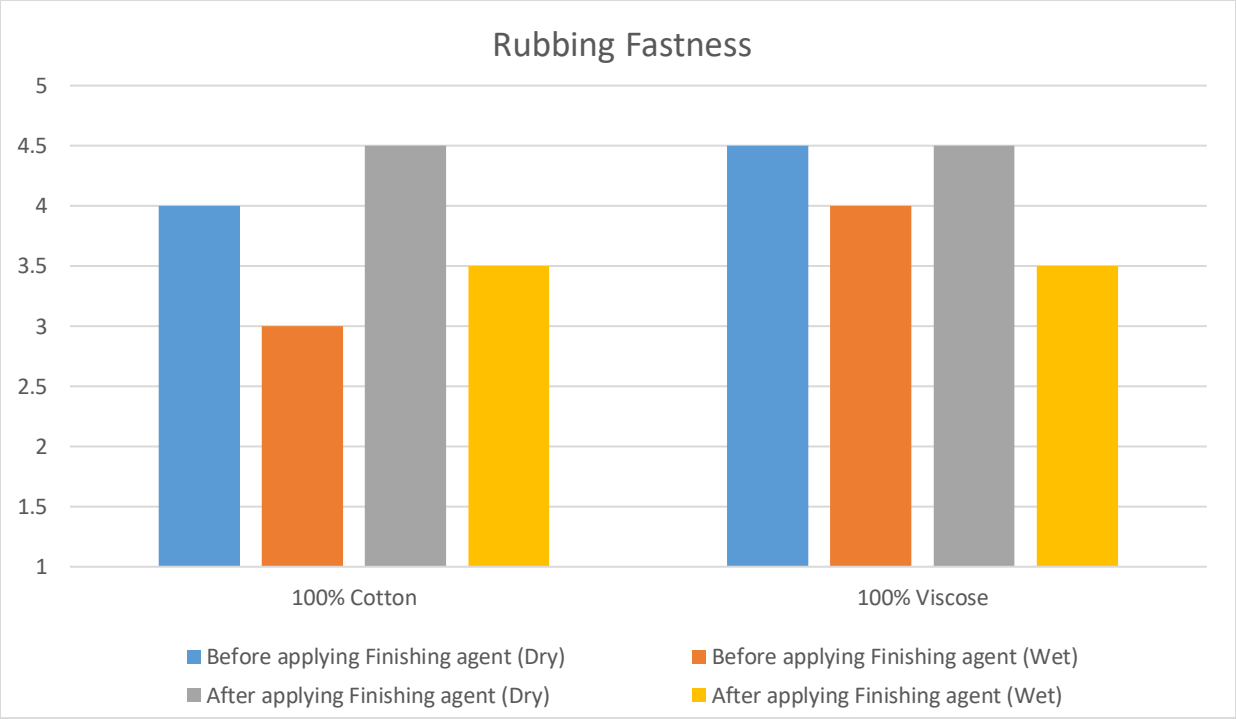


Figure: Bar diagram grade of rubbing fastness result for 100% Cotton & 100% Viscose fabric.

Discussion:

Here we can see that 100% cotton fabric the rubbing fastness is better after applying finishing agent than before finished sample.

And we also see that 100% viscose fabric the rubbing fastness is better after applying finishing agent than before finished sample.

4.4: Color Fastness to Wash test:

100% Cotton & 100% Viscose fabric color fastness to wash for 2% (Red) shade.

Sample	Color Change	Grading Scale (Staining)					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
Before Finish (Cotton)	4	4/5	4	4/5	3/4	4/5	3/4
After Finish (Cotton)	4/5	3/4	4/5	3/4	4/5	4/5	4
Before Finish (Viscose)	4/5	4	4/5	4/5	4	3/4	3
After Finish (Viscose)	4/5	4/5	4/5	3/4	4	4/5	3/4

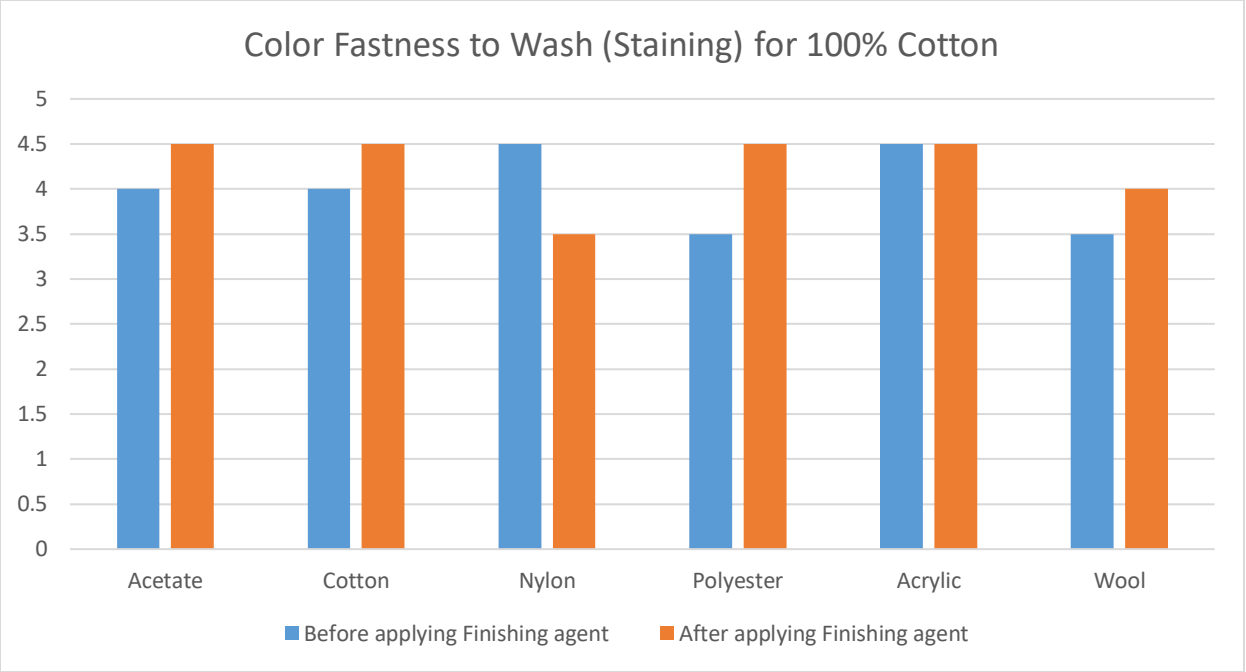


Figure: Bar diagram grade of washing fastness (Staining) result for 100% Cotton fabric.

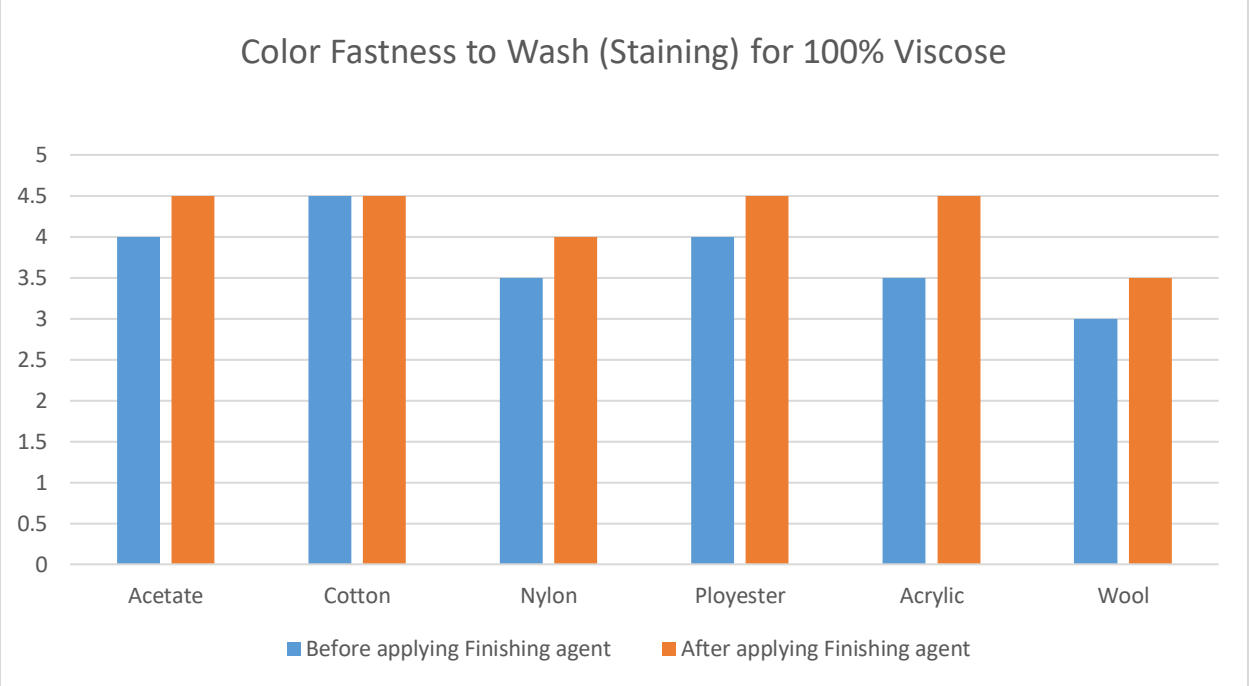


Figure: Bar diagram grade of washing fastness (Staining) result for 100% Viscose fabric.

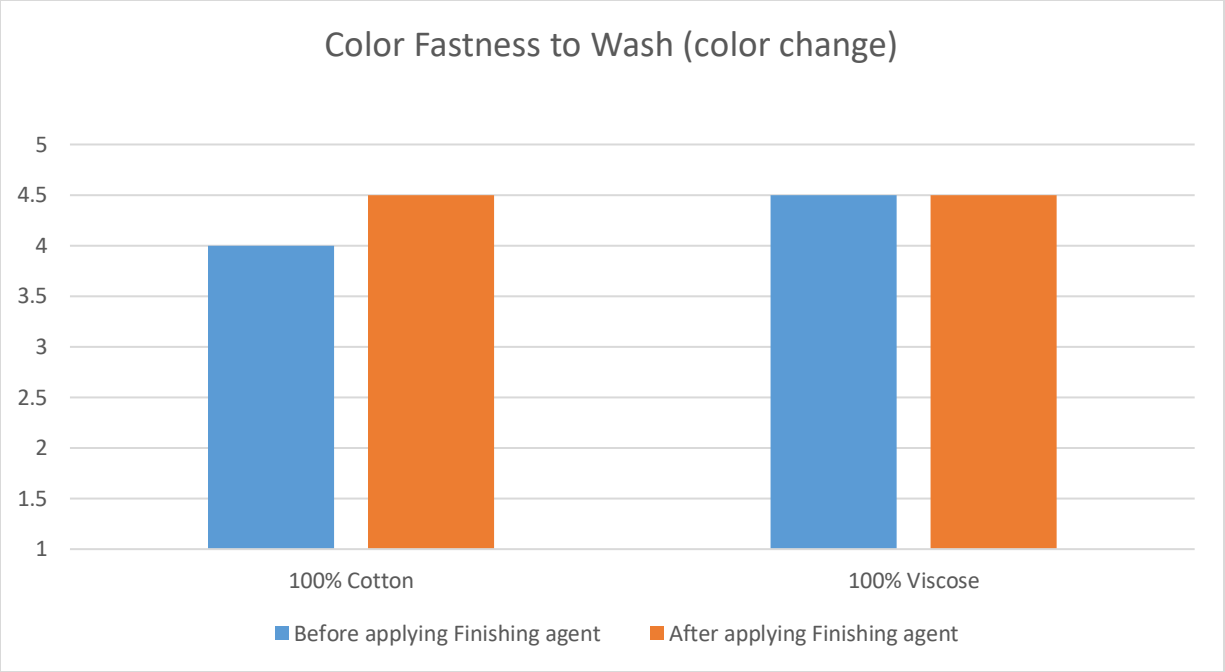


Figure: Bar diagram grade of washing fastness (Color change) result for 100% Cotton & 100% Viscose fabric.

Discussion:

Here we can say that the color fastness to wash for both sample is good. But in color change after applying finishing agent 100% cotton fabric fastness is better than before finished & in 100% viscose fabric color change is same.

And for color fastness to wash (staining) both 100% cotton & 100% viscose fabric after applying finishing agent is better than before finished sample.

Chapter: 05

Conclusion

Outcome:

- **Spectral analysis:**
  - ✓ Here R_{min} 540 nm & we found that reflectance value is more in viscose fabric than cotton fabric after applying finishing agent. So we can say that the shade become deeper in cotton fabric than viscose fabric after applying finishing agent.
  - ✓ K/S value very little increase in cotton fabric & little decrease in viscose fabric after applying finishing agent.
  - ✓ Colorimetric value indicate that cotton batch fabric are lighter, reddish & yellowish than standard sample. And viscose batch fabric are darker, greener & yellowish than standard sample. But color change value in both sample are acceptable.

- **Strength test:** After applying finishing agent the bursting strength of viscose fabric is increase twice than cotton fabric.

- **Color Fastness to rubbing test:** After applying finishing agent the rubbing fastness of viscose fabric is better than cotton fabric.

- **Color Fastness to wash test:** After applying finishing agent the wash fastness (color change & Staining) of viscose fabric is better than cotton fabric.

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Sample attachment

Before Finished Cotton	After Finished Cotton

Before Finished Viscose	After Finished Viscose