



Daffodil *International* **University**

Faculty of Engineering
Department of Textile Engineering

Course Code: TH-519

Course Title: Reuse of Discharged Liquor for Viscose Dyeing
Project (M.Sc in Textile Engineering)

Submitted By:	ID:	Supervised By:
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A thesis submitted in partial fulfillment of the requirement for the degree
Of Master of Science in Textile Engineering.

LETTER OF APPROVAL

January 8, 2025

To

The Head

Department of Textile Engineering

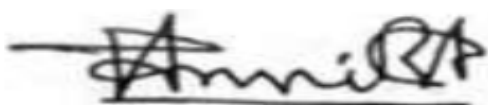
Subject: Approval of Project Report of M.Sc. in Textile Program.

Dear Sir,

I'm writing to inform you that the student with **ID 221-32-030** has finished the project report, "**Reuse of Discharged Liquor for Viscose Dyeing**," and it is ready for final review. The entire report is structured on appropriate research and interruption through thorough evaluation of empirical evidence with necessary components. Because the student was actively engaged in their project activities, the report was essential in providing readers with insightful information.

As a result, kindly accept this project report and take it into account for your final assessment.

Yours Sincerely



.....
Mr. Tanvir Ahmed Chowdhury

Head of the Department

Department of Textile Engineering

Faculty of Engineering

DECLARATION

I now certify that I completed this research under the guidance of Mr. Tanvir Ahmed Chowdhury, an assistant professor in the textile engineering department at Daffodil International University's faculty of engineering. Additionally, I affirm that neither this project nor any of its components have been submitted for consideration for a degree or certificate elsewhere.



Md. Monirul Islam

ID: 221-32-030

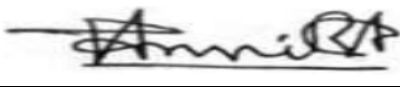
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This confirms that, to the best of our knowledge, the applicant's aforesaid declaration is accurate.

Supervisor:



Mr. Tanvir Ahmed Chowdhury

Head of the Department

Department of Textile Engineering

Faculty of Engineering

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I want to start by thanking the Almighty God for his wonderful grace, which enabled me to successfully finish this thesis. I express my gratitude to Tanvir Ahmed Chowdhury, my supervisor and the head of the Textile Engineering Department at Daffodil International University's Faculty of Engineering.

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For allowing me to utilise their lab, I am really grateful to **AKZOCHEM INDUSTRIES (BD) LTD.** and **APEX SPINNING AND KNITTING MILL LTD.**

I also want to express my gratitude to all of the instructors and fellow students at Daffodil International University who participated in the conversation while finishing the course work.

Finally, I would want to thank my loving parents, wife, and friends for their unwavering support, courage, and help during the thesis report writing process.

-The Author

**Dedication to Us
Respected Parents & Beloved Teacher.**

ABSTRACT

Bangladesh's economy is based on the ready-made clothing and textile industry. However, because textile manufacturers use a lot of water and eventually produce a lot of wastewater, they produce hazardous effluent for human health. One kilogramme of cotton cloth requires around 100 litres of water to colour. Therefore, a typical textile mill that uses only 15 tonnes of water per day uses roughly 1.5 million litres of water per day. Reusing wastewater is therefore a problem for the textile industry on both an ecological and financial level. Excluding the original manufacturing cost, the overall cost of wastewater reclamation was about 0.12 US dollars per cubic metre. The three reusable wastewater types—fixing, enzyme, and bleaching—that are used for viscose fabric in this study are not treated and are contrasted with regular input soft water.

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CHAPTER 01

INTRODUCTION

1.1 Background of the study

Viscose:

A semi-synthetic fibre derived from natural sources such as wood and agricultural goods, viscose is also referred to as rayon.

It is utilised in many different applications and shares a molecular structure with cellulose, such as:

- clothes: Because it is easier to maintain, absorbs moisture, and is kinder to the skin than synthetic fibres, viscose is frequently used in clothes. It feels like cotton and has a smooth appearance.
- Home furnishings: To prevent ignition, flame-retardant viscose is utilised in home furnishings.
- Paper and packaging: Paper and packaging are made from milled or powdered viscose rayon.
- Drilling oil wells, filtration, and cleanliness: These applications also make use of milled viscose rayon.
- Tire cord: Tire cord and other industrial uses require high tenacity rayon.

1.2 Objective of the study

- Viscose cloth was taken, and a variety of alternative water sources were chosen, such as soft water from the regular supply, bleaching water, enzyme water, and fixing water for dyeing with the same shade percentage.
- The purpose of this thesis is to advance knowledge of colourfastness testing and water reuse.
- Becomes acquainted with the criteria that must be identified prior to developing this thesis method.
- Get a firsthand grasp of the dyeing and testing preparation procedure.
- Becomes acquainted with the differences in the dyeing, water reuse, and test techniques.
- With on-test concepts, I will acquire a thorough comprehension of theoretical reactive dye.

1.3 Significance of study

- Differentiate fabric testing aids in guaranteeing that goods fulfil the required criteria for quality.
- It enables producers to spot any flaws or problems early on in the manufacturing process.
- The physical characteristics of textiles, including their ability to retain colour during washing, water, saliva, sweat, and other substances.
- ISO is one of several techniques that can be used for physical testing. Research-based production monitoring and product development evaluation

1.4 Limitation of study

- Reactive dyes' primary disadvantage is the need to guarantee dye attachment onto fibre. A significant amount of inorganic electrolyte must be added, and the dyeing process must be conducted in an alkaline media.
- Because it is challenging to get excellent homogenisation, reactive dyes are challenging to utilise.
- Though it is more difficult to get dark hues and some reactive dyes have poor washing fastness, especially for moderately deep colours, reactive dyes have better coverage of barre than acid dyes.
- The environment is not harmed by reactive dyes because they are non-toxic. They adhere to a number of environmental requirements and are free of heavy metals.

CHAPTER 02
LITERATURE REVIEW

The capability of recycling fabric wastewater after treatment has been verified by prior research. However, current methods for reusing corporate wastewater are not as cost-effective as readily available fresh water. Adsorption, coagulation, filtration, biological, electrochemical, ion exchange, supercritical water oxidation, primary, secondary, or biological treatment, tertiary, or advanced treatment, and preliminary treatment are some of the techniques used to treat textile wastewater. However, these waste water treatment systems are quite expensive, need a lot of processing time, and require a lot of maintenance. [1]

Since 1 kg of cotton fabric requires around 100 litres of water to dye, an average-sized textile mill with a daily capacity of only 15 tonnes uses roughly 1.5 million litres of water.[2], [3] On the other hand, viscose absorbs more than cotton. Water is used extensively in the manufacturing of viscose. In order to dye viscose fabric, a significant volume of water is required. [4]

observed that mercerising wastewater can be Moreover, the cooling water can be used directly in the process, the dye bath rinse water can be used for dye bath makeup, and the soaping wash water can be used for additional washing. [5]

However, the majority of reuse and wastewater treatment methods are unacceptable to factory owners because of the additional operational and maintenance expenses. Consequently, the method presented in this study can be a practical choice for the industrialist. Even without any water treatment, the current study offers a novel method for directly reusing textile effluent for viscose dyeing. Although there are no extra treatment expenses, it can save a substantial amount of freshwater that would otherwise be used for the same purpose. In order to compare the dyeing effect on viscose fabric and various fastness attributes, this study collected a variety of process waste water (bleaching, enzyme, and fixing water). Additionally, the characterisation of those used water was examined.

CHAPTER 03
EXPERIMENTAL DETAIL

BOD: Its maximum concentrations are 300 mg/L for disposal into sewer systems and 10 mg/L for direct environmental disposal. The BOD value is frequently used as a stand-in for the level of organic pollution in water and is most commonly stated in milligrammes of oxygen used per litre of sample during five days of incubation at 20 °C.

COD: Our COD analyser allows for real-time COD measurement, which enhances plant efficiency and wastewater process control. The Central Pollution Control Board's rules state that the COD is 250 mg/l.

TDS: All non-pure water sources contain dissolved ions, such as salts, minerals, and metals, which are referred to as total dissolved solids, or TDS for short. The majority of people consider TDS to be an aesthetic component. A panel of tasters in a World Health Organisation study reached the following results regarding the ideal concentration of TDS in water:

Label of TDS (Milligrams in letter)	Rating
Less than 300	Excellent
300 - 600	Good
600 - 900	Fair
900 - 1200	Poor
Above - 1200	Unacceptable

DO: The amount of oxygen in water is known as dissolved oxygen (DO). It is a crucial indicator of water quality since it shows how well a body of water can sustain aquatic life. Aquatic vegetation and the atmosphere both provide oxygen to bodies of water.

Hardness: The presence of soluble bicarbonates, chlorides, and calcium and magnesium sulphates causes the water to be hard. Water Hard water

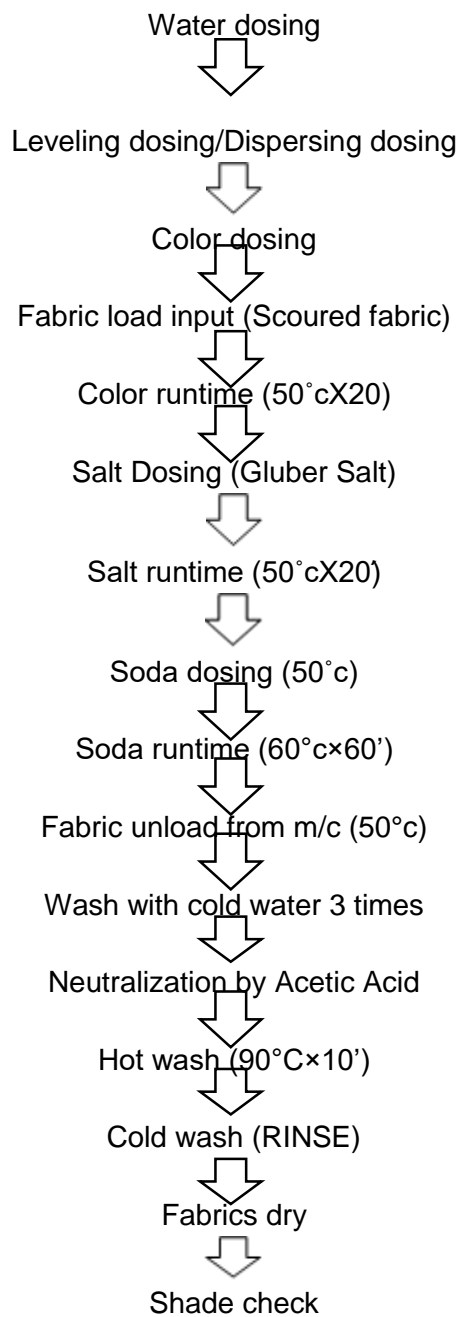
is what prevents soap from lathering. The most crucial element required for life to exist on Earth is water.

pH: The concentration of hydrogen ions, or PH, indicates how acidic or alkaline a solution is. Typically, the pH scale falls between 0 and 14. An acidic pH is less than 7, and an alkaline or basic pH is larger than 7. At 25°C, a pH of 7.0 is considered "neutral".The pH equation is $-\log[H^+] = \text{pH}$.

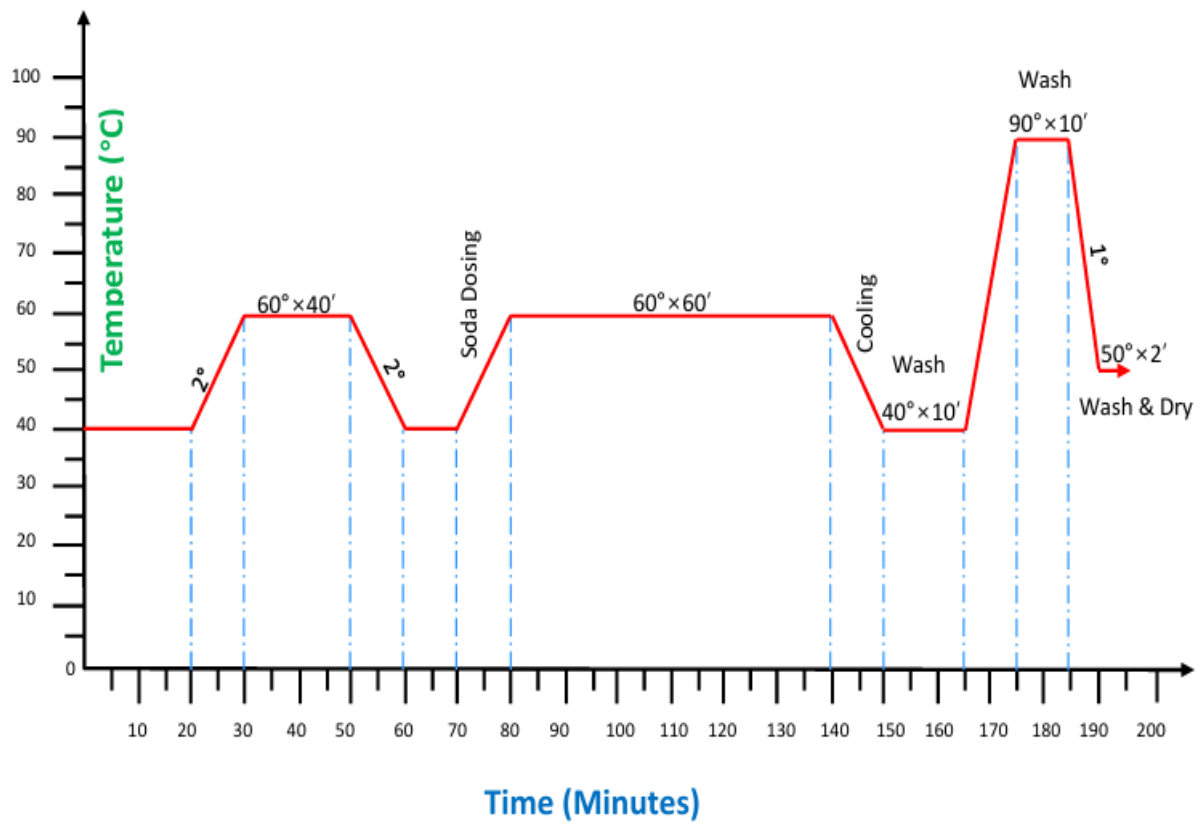
Characterization of water:

Parameter	Soft Water	Bleach Water	Enzyme Water	Fixing Water
pH	7.5	8.5	5.5	7.5
Total Hardness	3.5ppm	48.5ppm	60ppm	3ppm
Dissolve Oxygen	6.1mg/l	12.3mg/l	11.62	11.1mg/l
TDS	281mg/l	611mg/l	7.30	321mg/l
COD	14mg/l	1321mg/l	1328	56mg/l
BOD	0mg/l	192mg/l	0	2mg/l

3.0 Viscose Dyeing Working Process



3.1 Viscose Dyeing Process



3.1.1 Colorfastness to Rubbing (ISO 105 X-12)

3.1.2 Scope:

To ascertain how resistant various textiles' colors—including floor coverings and other pile fabrics—are to fading and discolouring other materials. [6, 7, 8]

3.1.3 Apparatus:

- Crock With a finger rubbing, master the downward force of (9) N and its track length (104 ± 3) mm (its diameter will be 16mm).
- A cotton cloth for rubbing: de-sized, bleached, 5x5 cm
- Greyscale, (ISO 105 A02 & ISO 105 A03)

3.1.4 Working Procedure (Dry Rubbing)

Condition the specimen in the standard environment for at least four hours prior to testing.



With the weave parallel to the direction of the rubbing finger, place the conditioned rubbing cloth flat over the finger's end.



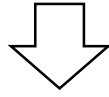
Rub in a straight line 20 times, 10 times to and 10 times fro, at a pace of one cycle per second.

3.1.5 Evaluation:

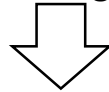
- When evaluating, cover each tested rubbing cloth with three layers of white rubbing cloth.
- Use the grey scale to evaluate the cotton rubbing cloths' stains under appropriate lighting.

3.1.6 Working Procedure (Wet Rubbing)

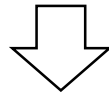
Condition the specimen in the standard environment for at least four hours prior to testing.



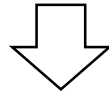
To assure 95% to 100% take-up, weigh a conditioned piece of fabric, soak it fully in distilled water, and then weigh it again to establish a method for making rubbing cloth.



With the weave parallel to the direction of the rubbing finger, place the conditioned rubbing cloth flat over the finger's end.



Rub in a straight line 20 times, 10 times to and 10 times fro, at a pace of one cycle per second.



Let the test cloth air dry.

3.1.7 Evaluation:

- When evaluating, cover each tested rubbing cloth with three layers of white rubbing cloth.
- Use the grey scale to evaluate the cotton rubbing cloths' stains under appropriate lighting.

3.1.8 Viscose Color Fastness to Rubbing Test Report (Soft water)



APEX Textile Testing

Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:		Color Name:	Red
GSM:	160	Fabrication:	100% Viscose
Date:	10/12/24	Light Source:	D65

COLOR FASTNESS TO RUBBING ISO 105 X 12:2001


Length Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Face)	Wet Rubbing (Face)	Wet Pick Up = 96%
Grading: 4.5	Grading: 4	Grading: 2	

Width Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Back)	Wet Rubbing (Back)	Wet Pick Up = 97%
Grading: 4.5	Grading: 4	Grading: 2	

3.1.9 Viscose Color Fastness to Rubbing Test Report (Bleaching Water)



APEX Textile Testing


Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN


Test Report No:		Original Swatch-Color	
Buyer:		Color Name:	Red
GSM:	160	Fabrication:	100% Viscose
Date:	10/12/24	Light Source:	D65

COLOR FASTNESS TO RUBBING ISO 105 X 12:2001

Length Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Face)	Wet Rubbing (Face)	Wet Pick Up = 98%
			
Grading: 4-5	Grading: 4	Grading: 2-3	

Width Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Back)	Wet Rubbing (Back)	Wet Pick Up = 96%
			
Grading: 4-5	Grading: 4	Grading: 2	

3.1.9 Viscose Color Fastness to Rubbing Test Report (Enzyme Water)



APEX Textile Testing


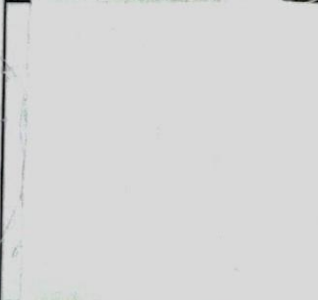
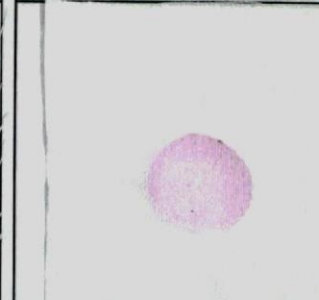
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EXHIBIT TESTED SPECIMEN

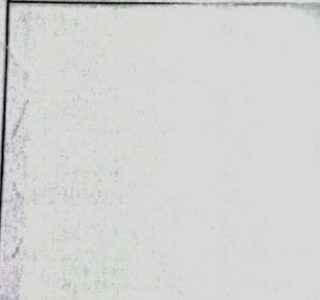
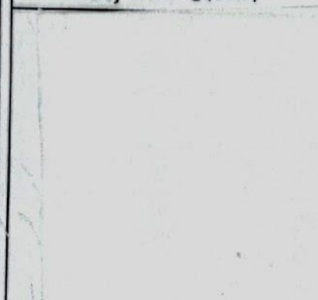
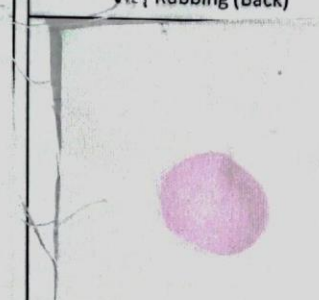
Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100% Viscose	
Date:	10/12/24	Light Source:	D65	

COLOR FASTNESS TO RUBBING ISO 105 X 12:2001

Length Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Face)	Wet Rubbing (Face)	Wet Pick Up = 99%
			
Grading: 4.5	Grading: 4	Grading: 2	

Width Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Back)	Wet Rubbing (Back)	Wet Pick Up = 98%
			
Grading: 4.5	Grading: 4	Grading: 2-3	

3.2 Viscose Color Fastness to Rubbing Test Report (Fixing Water)



APEX Textile Testing

Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100% Viscose	
Date:	10/12/24	Light Source:	D65	

COLOR FASTNESS TO RUBBING ISO 105 X 12:2001

Length Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Face)	Wet Rubbing (Face)	Wet Pick Up = 96%
Grading: 4-5	Grading: 4	Grading: 2	

Width Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Back)	Wet Rubbing (Back)	Wet Pick Up = 99%
Grading: 4-5	Grading: 4	Grading: 2	

3.3 Colorfastness to Wash (ISO 105 C06 A2S)

3.3.1 Scope:

to ascertain how resistant the colour of textiles of all types and in all forms is to commercial or domestic laundry processes that are utilised for everyday household items. [7], [8], and [9]

3.3.2 Apparatus, materials, and reagent:

- 550ml stainless steel still container
- Still balls made of stainless (6mm)
- ECE formulation for the Washcator Machine Phosphate reference (A) = 4g/L
- Test Specimen: 4x10 cm and Multifiber, 4x10 cm
- Sodium Perborate 1g/L
- Grade -3 Grey Scal Water
- Incubator
- (ISO 105 A02 & ISO 105 A03)

3.3.3 Working Procedure

Use a swing to secure the specimen and multifiber.
↓
Place ten stainless still balls in a 150 ml solution in a stainless still container.
↓
40°C is the set temperature.
↓
Run for thirty minutes.
↓
Dry in an incubator set below 60 degrees Celsius.
↓
Examine the colour staining and colour shift at the D65 light source.

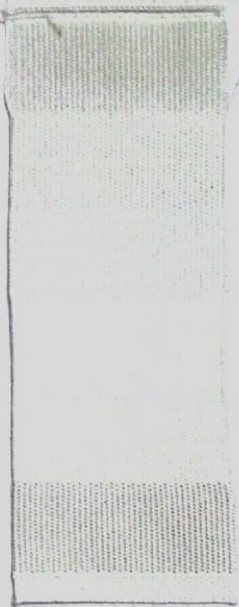
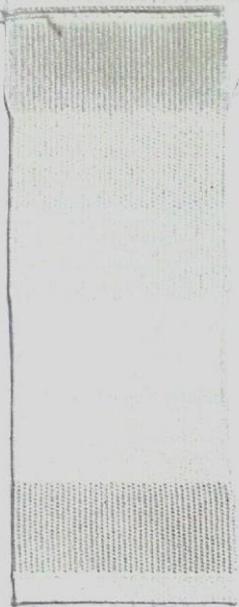

3.3.4 Viscose Color Fastness to Wash Test Report (Soft Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO WASH ISO 105 C06 A25:1987

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading																
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td colspan="2" style="text-align: center;">Grading of color change</td></tr> <tr><td colspan="2" style="text-align: center;"><i>4</i></td></tr> </table>	Wool	<i>4.5</i>	Acrylic	<i>4.5</i>	Polyester	<i>4.5</i>	Nylon	<i>4.5</i>	Cotton	<i>4.5</i>	Acetate	<i>4.5</i>	Grading of color change		<i>4</i>	
Wool	<i>4.5</i>																		
Acrylic	<i>4.5</i>																		
Polyester	<i>4.5</i>																		
Nylon	<i>4.5</i>																		
Cotton	<i>4.5</i>																		
Acetate	<i>4.5</i>																		
Grading of color change																			
<i>4</i>																			

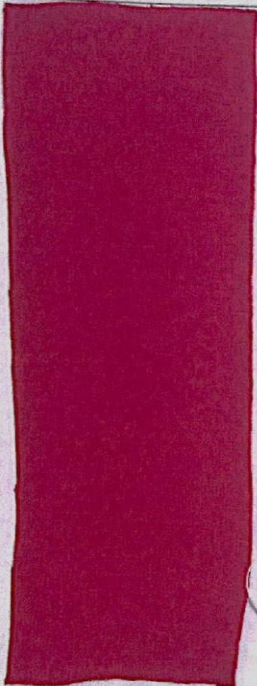
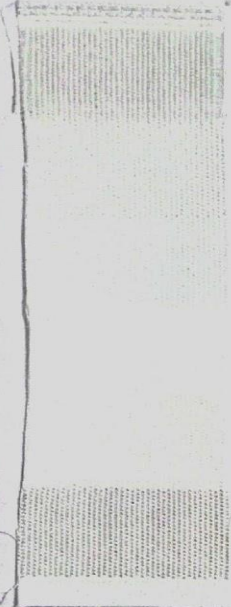

3.3.5 Viscose Color Fastness to Wash Test Report (Bleaching Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% Viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO WASH ISO 105 C06 A2S:1987

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
															
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>2-3</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> </table>	Wool	<i>4-5</i>	Acrylic	<i>4</i>	Polyester	<i>4-5</i>	Nylon	<i>4-5</i>	Cotton	<i>2-3</i>	Acetate	<i>4-5</i>
Wool	<i>4-5</i>														
Acrylic	<i>4</i>														
Polyester	<i>4-5</i>														
Nylon	<i>4-5</i>														
Cotton	<i>2-3</i>														
Acetate	<i>4-5</i>														
			Grading of color change <i>3-4</i>												




3.3.6 Viscose Color Fastness to Wash Test Report (Enzyme Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <u>Red</u>		
GSM: <u>160</u>	Fabrication: <u>100% Viscose</u>		
Date: <u>10/12/24</u>	Light Source: <u>D65</u>		

COLOR FASTNESS TO WASH ISO 105 C06 A2S:1987

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading
			
			Wool
			Acrylic
			Polyester
			Nylon
			Cotton
			Acetate
			Grading of color change
			4.5

3.3.7 Viscose Color Fastness to Wash Test Report (Fixing Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO WASH ISO 105 C06 A2S:1987

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> </table>	Wool	<i>4-5</i>	Acrylic	<i>4-5</i>	Polyester	<i>4-5</i>	Nylon	<i>4-5</i>	Cotton	<i>4-5</i>	Acetate	<i>4-5</i>
Wool	<i>4-5</i>														
Acrylic	<i>4-5</i>														
Polyester	<i>4-5</i>														
Nylon	<i>4-5</i>														
Cotton	<i>4-5</i>														
Acetate	<i>4-5</i>														
Grading of color change			<i>4</i>												

3.4 Colorfastness to Water (ISO 105 E-01)

3.4.1 Scope:

to ascertain how resistant various types of coloured textiles are to submersion in water. [7], [9]

3.4.2 Apparatus and reagent:

- Piece of weight: 5 kilogramme
- Examine the specimen 11-piece, 4x10 centimetre acrylic glass plate
- Oven with Multifiber, 4x10 cm, 37°C
- Grade 3: Grey Scale Perspiration meter with flat bottom (ISO 105 A02 & ISO 105 A03)

3.4.3 Working Procedure

Use a swing to secure the specimen and multifiber.



In a flat-bottomed dish, thoroughly wet out by submerging in grade -3 water at room temperature for half an hour.



Place two acrylic glass plates between them and apply a 5 kg pressure stress.



For four hours, place the Perspiro meter in an oven set to 37°C.



Dry at 60°C in an incubator.



Examine the colour staining and colour shift at the D65 light source.


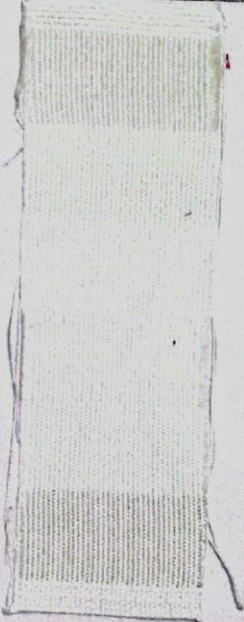
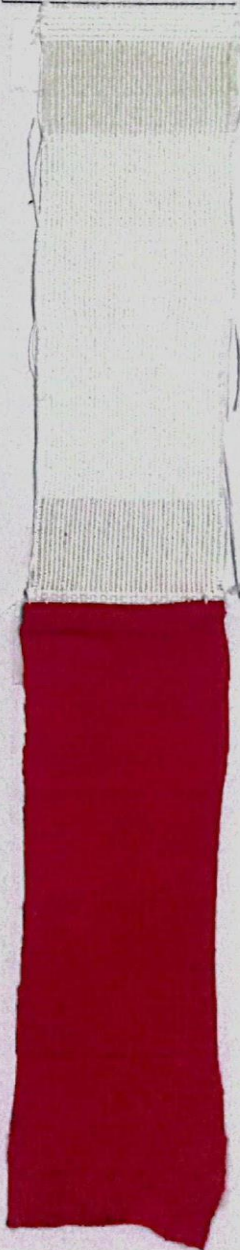
3.4.4 Viscose Color Fastness to Water Test Report (Soft Water)

APEX Textile Testing Lab-QA: 501, V.1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <u>Red</u>		
GSM: <u>160</u>	Fabrication: <u>100% Viscose</u>		
Date: <u>10/12/24</u>	Light Source: <u>D65</u>		

COLOR FASTNESS TO WATER ISO 105 E01:2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">V'ool</td><td style="text-align: center;">4-5</td></tr> <tr><td style="text-align: center;">Acrylic</td><td style="text-align: center;">4-5</td></tr> <tr><td style="text-align: center;">Polyester</td><td style="text-align: center;">4-5</td></tr> <tr><td style="text-align: center;">Nylon</td><td style="text-align: center;">4-5</td></tr> <tr><td style="text-align: center;">Cotton</td><td style="text-align: center;">4-5</td></tr> <tr><td style="text-align: center;">Acetate</td><td style="text-align: center;">4-5</td></tr> </table>	V'ool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	4-5	Acetate	4-5
V'ool	4-5														
Acrylic	4-5														
Polyester	4-5														
Nylon	4-5														
Cotton	4-5														
Acetate	4-5														
Grading of color change			4												




3.4.5 Viscose Color Fastness to Water Test Report (Bleaching Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <u>Red</u>		
GSM: <u>160</u>	Fabrication: <u>100% Viscose</u>		
Date: <u>10/12/24</u>	Light Source: <u>D65</u>		

COLOR FASTNESS TO WATER ISO 105 E01:2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;">4.5</td></tr> <tr><td>Acrylic</td><td style="text-align: center;">4.5</td></tr> <tr><td>Polyester</td><td style="text-align: center;">4.5</td></tr> <tr><td>Nylon</td><td style="text-align: center;">4.5</td></tr> <tr><td>Cotton</td><td style="text-align: center;">4.5</td></tr> <tr><td>Acetate</td><td style="text-align: center;">4.5</td></tr> </table>	Wool	4.5	Acrylic	4.5	Polyester	4.5	Nylon	4.5	Cotton	4.5	Acetate	4.5
Wool	4.5														
Acrylic	4.5														
Polyester	4.5														
Nylon	4.5														
Cotton	4.5														
Acetate	4.5														
Grading of color change			4												


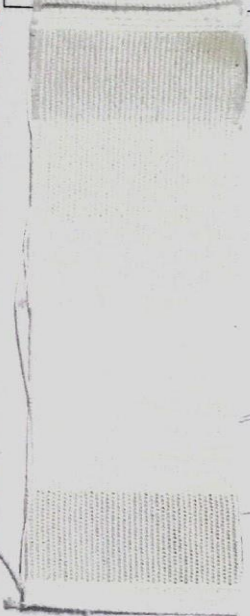

3.4.6 Viscose Color Fastness to Water Test Report (Enzyme Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% Viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO WATER ISO 105 E01:2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>2-3</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Grading of color change</td><td style="text-align: center;"><i>4</i></td></tr> </table>	Wool	<i>4-5</i>	Acrylic	<i>4</i>	Polyester	<i>4-5</i>	Nylon	<i>4</i>	Cotton	<i>2-3</i>	Acetate	<i>4-5</i>	Grading of color change	<i>4</i>
Wool	<i>4-5</i>																
Acrylic	<i>4</i>																
Polyester	<i>4-5</i>																
Nylon	<i>4</i>																
Cotton	<i>2-3</i>																
Acetate	<i>4-5</i>																
Grading of color change	<i>4</i>																


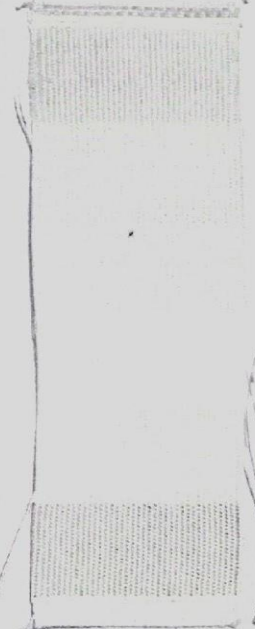

3.4.7 Viscose Color Fastness to Water Test Report (Fixing Water)

APEX Textile Testing Lab-QA: 501, V-I, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Color Name: <u>Red</u>		Original Swatch-Color
Buyer:		Fabrication: <u>100% Viscose</u>		
GSM: <u>160</u>		Light Source: <u>D65</u>		
Date: <u>10/12/24</u>				

COLOR FASTNESS TO WATER ISO 105 E01:2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;">4-5</td></tr> <tr><td>Acrylic</td><td style="text-align: center;">4-5</td></tr> <tr><td>Polyester</td><td style="text-align: center;">4-5</td></tr> <tr><td>Nylon</td><td style="text-align: center;">4-5</td></tr> <tr><td>Cotton</td><td style="text-align: center;">3</td></tr> <tr><td>Acetate</td><td style="text-align: center;">4-5</td></tr> <tr><td>Grading of color change</td><td style="text-align: center;">9</td></tr> </table>	Wool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	3	Acetate	4-5	Grading of color change	9
Wool	4-5																
Acrylic	4-5																
Polyester	4-5																
Nylon	4-5																
Cotton	3																
Acetate	4-5																
Grading of color change	9																

3.5 Color fastness to perspiration (ISO 105 E04)

3.5.1 Scope:

to ascertain how resistant the colour of textiles in all shapes and sizes is to the effects of human sweat.[10]

3.5.2 Apparatus and materials:

- Piece of weight: 5 kilogramme
- Examine the specimen 11-piece, 4x10 centimetre acrylic glass plate
- Oven with Multifiber, 4x10 cm, 37°C
- Water Container of Grade -3
- The perspiration meter
- Grey Scale Incubator (ISO 105 A02 & ISO 105 A03)

3.5.3 Acid solution & Alkaline solution

Acid Solution:

- 0.5 grammes of monohydrochloride monohydrate of l-histidine
- Five grammes of NaCl (sodium chloride)
- 2.2 grammes of dehydrated sodium dihydrogen orthophosphate
- 0.1 mol/l sodium hydroxide solution is added to the solution to bring its pH down to 5.5 (± 0.2).

Alkaline Solution:

- 0.5 grammes of monohydrochloride monohydrate of l-histidine
- Five grammes of NaCl (sodium chloride)
- 2.5 grammes of dihydrate of disodium hydrogen orthophosphate
- 0.1 mol/l sodium hydroxide solution is used to bring the solution's pH down to 8 (± 0.2).

3.5.4 Working Procedure

Use a swing to secure the specimen and multifiber.



Wet thoroughly in a flat-bottomed dish by letting the acid and alkaline solutions sit at room temperature for half an hour.



Place two acrylic glass plates between them and apply a 5 kg pressure stress.



For four hours, place the Perspiro meter in an oven set to 37°C.



Dry at 60°C in an incubator.



Examine the colour staining and colour shift at the D65 light source.





3.5.5 Viscose Perspiration (Acid) Test Report (Soft Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color
Buyer:		Color Name: <i>Red</i>
GSM: <i>160</i>		Fabrication: <i>100% Viscose</i>
Date: <i>10/12/24</i>		Light Source: <i>D65</i>

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> </table>	Wool	<i>4-5</i>	Acrylic	<i>4-5</i>	Polyester	<i>4-5</i>	Nylon	<i>4-5</i>	Cotton	<i>4-5</i>	Acetate	<i>4-5</i>
Wool	<i>4-5</i>														
Acrylic	<i>4-5</i>														
Polyester	<i>4-5</i>														
Nylon	<i>4-5</i>														
Cotton	<i>4-5</i>														
Acetate	<i>4-5</i>														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">Grading of color change</td> <td style="text-align: center; vertical-align: middle;"><i>4</i></td> </tr> </table>	Grading of color change	<i>4</i>										
Grading of color change	<i>4</i>														


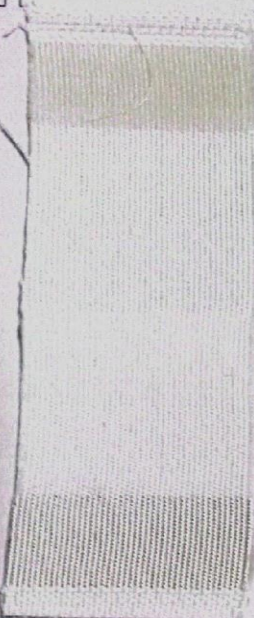
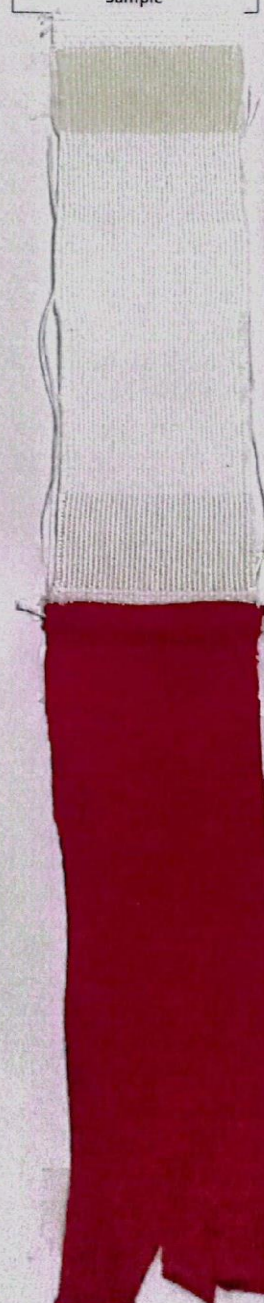
3.5.6 Viscose Perspiration (Alkaline) Test Report (Soft Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:			Original Swatch-Color
Buyer:			
GSM:	160	Color Name:	Red
Date:	10/12/20	Fabrication:	100% Viscose
		Light Source:	D65

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04: 2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td>4.5</td></tr> <tr><td>Acrylic</td><td>4.5</td></tr> <tr><td>Polyester</td><td>4.5</td></tr> <tr><td>Nylon</td><td>4.5</td></tr> <tr><td>Cotton</td><td>4.5</td></tr> <tr><td>Acetate</td><td>4.5</td></tr> </table>	Wool	4.5	Acrylic	4.5	Polyester	4.5	Nylon	4.5	Cotton	4.5	Acetate	4.5
Wool	4.5														
Acrylic	4.5														
Polyester	4.5														
Nylon	4.5														
Cotton	4.5														
Acetate	4.5														
Grading of color change			4												



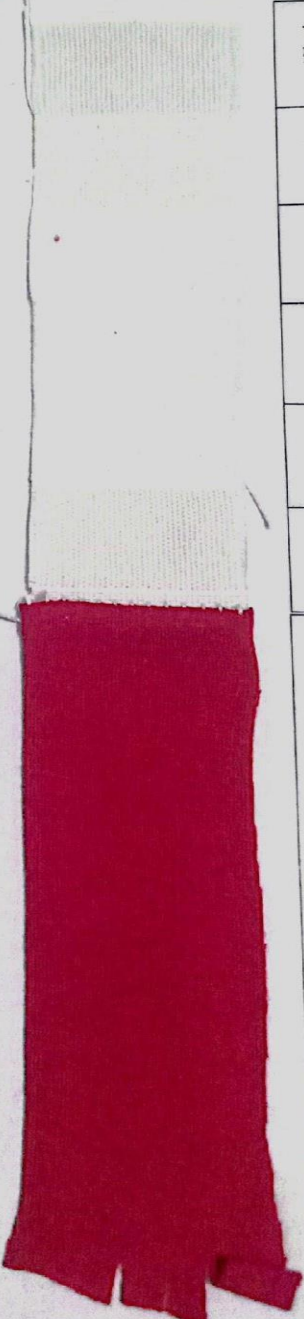
3.5.7 Viscose Perspiration (Acid) Test Report (Bleaching Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100% viscose	
Date:	10/12/24	Light Source:	D65	

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td>4-5</td></tr> <tr><td>Acrylic</td><td>4-5</td></tr> <tr><td>Polyester</td><td>4-5</td></tr> <tr><td>Nylon</td><td>4-5</td></tr> <tr><td>Cotton</td><td>4</td></tr> <tr><td>Acetate</td><td>4-5</td></tr> <tr><td>Grading of color change</td><td>4</td></tr> </table>	Wool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	4	Acetate	4-5	Grading of color change	4
Wool	4-5																
Acrylic	4-5																
Polyester	4-5																
Nylon	4-5																
Cotton	4																
Acetate	4-5																
Grading of color change	4																


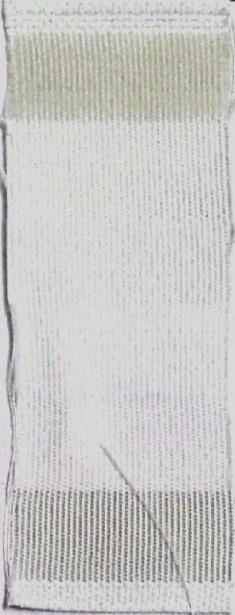

3.5.8 Viscose Perspiration (Alkaline) Test Report (Bleaching Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Color Name: <u>Red</u>		Original Swatch-Color	
Buyer:		Fabrication: <u>100% Viscose</u>			
GSM: <u>160</u>		Light Source: <u>D65</u>			
Date: <u>10/12/24</u>					

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04: 2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;">4.5</td></tr> <tr><td>Acrylic</td><td style="text-align: center;">4.5</td></tr> <tr><td>Polyester</td><td style="text-align: center;">4.5</td></tr> <tr><td>Nylon</td><td style="text-align: center;">4.5</td></tr> <tr><td>Cotton</td><td style="text-align: center;">4.5</td></tr> <tr><td>Acetate</td><td style="text-align: center;">4.5</td></tr> </table>	Wool	4.5	Acrylic	4.5	Polyester	4.5	Nylon	4.5	Cotton	4.5	Acetate	4.5
Wool	4.5														
Acrylic	4.5														
Polyester	4.5														
Nylon	4.5														
Cotton	4.5														
Acetate	4.5														
Grading of color change			4												


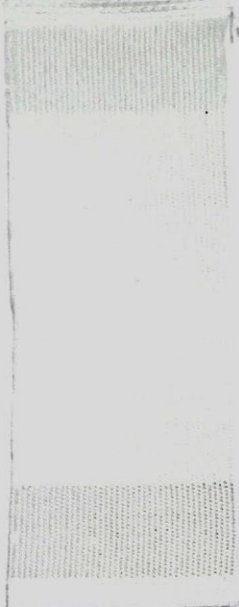

3.5.9 Viscose Perspiration (Acid) Test Report (Enzyme Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100% Viscose	
Date:	10/12/20	Light Source:	D65	

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td>4-5</td></tr> <tr><td>Acrylic</td><td>4-5</td></tr> <tr><td>Polyester</td><td>4-5</td></tr> <tr><td>Nylon</td><td>4-5</td></tr> <tr><td>Cotton</td><td>3</td></tr> <tr><td>Acetate</td><td>4-5</td></tr> </table>	Wool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	3	Acetate	4-5
Wool	4-5														
Acrylic	4-5														
Polyester	4-5														
Nylon	4-5														
Cotton	3														
Acetate	4-5														
Grading of color change			4												




3.6 Viscose Perspiration (Alkaline) Test Report (Enzyme Water)

APEX Textile Testing Lab-QA- 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:			Original Swatch-Color
Buyer:		Color Name: <i>Red</i>	
GSM: <i>160</i>		Fabrication: <i>100% Viscose</i>	
Date: <i>10/12/24</i>		Light Source: <i>D65</i>	

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04: 2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>2-3</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> </table>	Wool	<i>5</i>	Acrylic	<i>4</i>	Polyester	<i>4-5</i>	Nylon	<i>4</i>	Cotton	<i>2-3</i>	Acetate	<i>4-5</i>
Wool	<i>5</i>														
Acrylic	<i>4</i>														
Polyester	<i>4-5</i>														
Nylon	<i>4</i>														
Cotton	<i>2-3</i>														
Acetate	<i>4-5</i>														
Grading of color change			<i>4</i>												


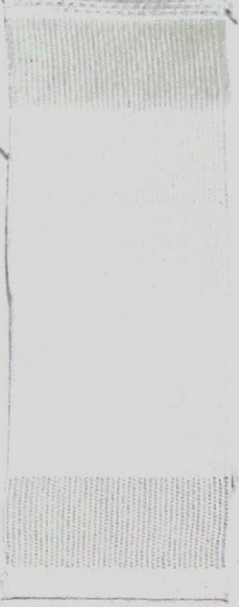
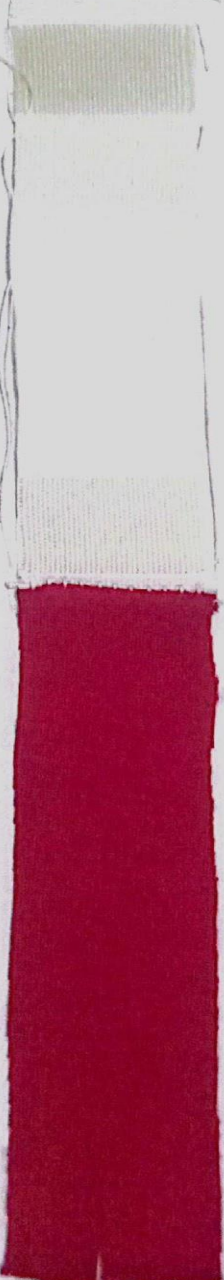
3.6.1 Viscose Perspiration (Acid) Test Report (Fixing Water)

APEX Textile Testing Lab-QA: 501, V.1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Color Name: <u>Red</u>		Original Swatch-Color
Buyer:		Fabrication: <u>100% Viscose</u>		
GSM: <u>160</u>	Date: <u>10/12/24</u>	Light Source: <u>D65</u>		

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04: 2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td><u>4.5</u></td></tr> <tr><td>Acrylic</td><td><u>4.5</u></td></tr> <tr><td>Polyester</td><td><u>4.5</u></td></tr> <tr><td>Nylon</td><td><u>4.5</u></td></tr> <tr><td>Cotton</td><td><u>4.5</u></td></tr> <tr><td>Acetate</td><td><u>4.5</u></td></tr> </table>	Wool	<u>4.5</u>	Acrylic	<u>4.5</u>	Polyester	<u>4.5</u>	Nylon	<u>4.5</u>	Cotton	<u>4.5</u>	Acetate	<u>4.5</u>
Wool	<u>4.5</u>														
Acrylic	<u>4.5</u>														
Polyester	<u>4.5</u>														
Nylon	<u>4.5</u>														
Cotton	<u>4.5</u>														
Acetate	<u>4.5</u>														
Grading of color change			<u>4</u>												



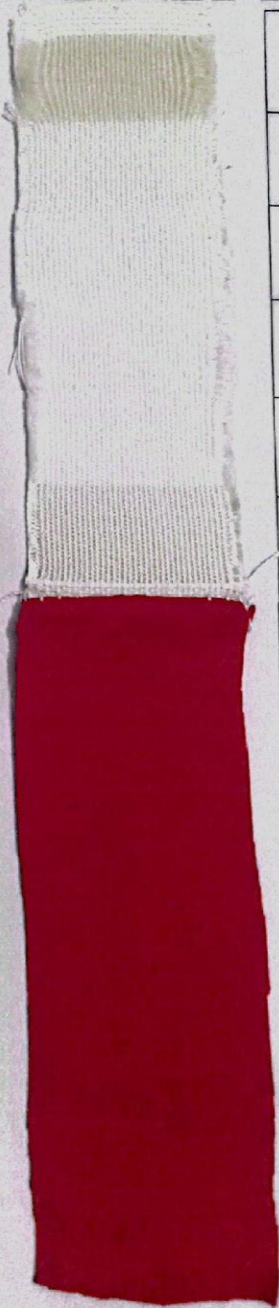
3.6.2 Viscose Perspiration (Alkaline) Test Report (Fixing Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:			Original Swatch-Color
Buyer:		Color Name: <u>Red</u>	
GSM: <u>160</u>		Fabrication: <u>100% Viscose</u>	
Date: <u>10/12/24</u>		Light Source: <u>D65</u>	

COLOR FASTNESS TO PERSPIRATION ACID ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;">4-5</td></tr> <tr><td>Acrylic</td><td style="text-align: center;">4-5</td></tr> <tr><td>Polyester</td><td style="text-align: center;">4-5</td></tr> <tr><td>Nylon</td><td style="text-align: center;">4-5</td></tr> <tr><td>Cotton</td><td style="text-align: center;">4-5</td></tr> <tr><td>Acetate</td><td style="text-align: center;">4-5</td></tr> <tr><td>Grading of color change</td><td style="text-align: center;">4</td></tr> </table>	Wool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	4-5	Acetate	4-5	Grading of color change	4
Wool	4-5																
Acrylic	4-5																
Polyester	4-5																
Nylon	4-5																
Cotton	4-5																
Acetate	4-5																
Grading of color change	4																

3.7 Color Fastness to Household Laundering (H&M TM CF: 03)

3.7.1 Scope:

Assess the textiles' colour fastness to domestic washing.

3.7.2 Equipment:

- Price Tag Gun Multifiber DW Light source D65
- Colour Change Grey Scale (ISO 105 A02)
- Staining Grey Scale (ISO 105 A03)
- One example of each material and colour

3.7.3 Working Procedure

Multifiber cut, 4 x 10 cm



Attach the multifiber to the specimen using a tag gun.



Cutting fabric for evaluation



Wash in accordance with the care instructions.



Multifiber needs to be dried individually and in line.



Dry the specimen as directed per the care instructions.





3.7.4 Viscose Color Fastness to Household Laundering Test Report (Soft Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100%etn	
Date:	10/12/24	Light Source:	D65	

COLOR FASTNESS TO HOUSEHOLD LAUNDERING H&M TM CF: 03: 2014

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td>4.5</td></tr> <tr><td>Acrylic</td><td>4.5</td></tr> <tr><td>Polyester</td><td>4.5</td></tr> <tr><td>Nylon</td><td>4.5</td></tr> <tr><td>Cotton</td><td>4.5</td></tr> <tr><td>Acetate</td><td>4.5</td></tr> </table>	Wool	4.5	Acrylic	4.5	Polyester	4.5	Nylon	4.5	Cotton	4.5	Acetate	4.5
Wool	4.5														
Acrylic	4.5														
Polyester	4.5														
Nylon	4.5														
Cotton	4.5														
Acetate	4.5														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Grading of color change</td> <td style="text-align: center;">4</td> </tr> </table>	Grading of color change	4										
Grading of color change	4														




3.7.5 Viscose Color Fastness to Household Laundering Test Report (Bleaching Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100% Viscose	
Date:	10/12/24	Light Source:	D65	

COLOR FASTNESS TO HOUSEHOLD LAUNDERING H&M TM CF: 03: 2014

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading
			
			Wool
			Acrylic
			Polyester
			Nylon
			Cotton
			Acetate
			Grading of color change
			4



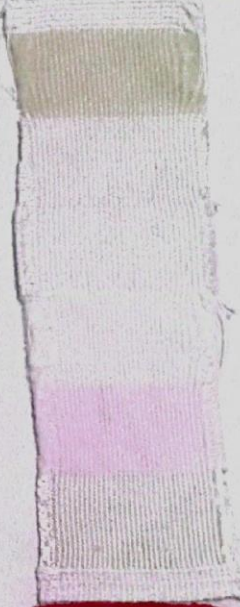
3.7.6 Viscose Color Fastness to Household Laundering Test Report (Enzyme Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100% Viscose	
Date:	10/12/24	Light Source:	D65	

COLOR FASTNESS TO HOUSEHOLD LAUNDERING H&M TM CF: 03: 2014

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading
			
			Wool 4.5
			Acrylic 4.5
			Polyester 4.5
			Nylon 4.5
			Cotton 3
			Acetate 4.5
			Grading of color change 4

3.7.7 Viscose Color Fastness to Household Laundering Test Report (Fixing Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Red	
GSM:	160	Fabrication:	100% Viscose	
Date:	10/12/24	Light Source:	D65	

COLOR FASTNESS TO HOUSEHOLD LAUNDERING H&M TM CF: 03: 2014

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading														
																	
																	
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td>4-5</td></tr> <tr><td>Acrylic</td><td>4-5</td></tr> <tr><td>Polyester</td><td>4-5</td></tr> <tr><td>Nylon</td><td>4-5</td></tr> <tr><td>Cotton</td><td>4-5</td></tr> <tr><td>Acetate</td><td>4-5</td></tr> <tr><td>Grading of color change</td><td>4</td></tr> </table>	Wool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	4-5	Acetate	4-5	Grading of color change	4
Wool	4-5																
Acrylic	4-5																
Polyester	4-5																
Nylon	4-5																
Cotton	4-5																
Acetate	4-5																
Grading of color change	4																

3.8 Color Fastness to Saliva (GB/TI 18886)

3.8.1 Scope:

To ascertain the textiles' colour resistance to saliva in accordance with [11]

3.8.2 Equipment:

- Perspirometer 11 with glass or acrylic-resin plates
- Dishes with a flat bottom
- The oven is kept at $(37\pm 2)^{\circ}\text{C}$.
- A light source and a light box D65
- Colour shift is measured using a grey scale (ISO 105-A02).
- Staining evaluation using a grey scale (ISO 105-A03)
- Adjacent multifiber fabric, type DW (ISO 105-F10)
- Ingredients for the saliva solution (refer to solution preparation)
- Grade 3 distilled water scale

3.8.3 Preparation of solution

- Chloride of sodium = 0.33g/L
- 0.75g/L of potassium chloride
- Carbonate of potassium = 0.53g/L
- Chloride of calcium 0.15g/L of dehydrate
- Xhydrate of magnesium chloride = 0.17g/L
- Tryhydrate of potassium hydrogen phosphate = 0.76g/L
- 100 ml of solution dissolves in 30 minutes.
- Ph = 6.8 ± 0.2 pH Control = around 60–70 ml of hydrogen chloride

3.8.4 Working Procedure

Use a swing to secure the specimen and multifiber.



thoroughly moistened in a flat-bottomed plate by letting the alkaline and saliva solutions sit at room temperature for half an hour.



Place two acrylic glass plates between them and apply a 5 kg pressure stress.



For four hours, place the Perspiro meter in an oven set to 37°C.



Dry at less than 60°C in an incubator.



Examine the colour staining and colour shift at the D65 light source.




3.8.5 Viscose Color Fastness to Saliva Test Report (Soft Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <u>Red</u>		
GSM: <u>160</u>	Fabrication: <u>100% Viscose</u>		
Date: <u>10/12/24</u>	Light Source: <u>D65</u>		

COLOR FASTNESS TO SALIVA GB/T18886: 2019

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;">4.5</td></tr> <tr><td>Acrylic</td><td style="text-align: center;">4.5</td></tr> <tr><td>Polyester</td><td style="text-align: center;">4.5</td></tr> <tr><td>Nylon</td><td style="text-align: center;">4.5</td></tr> <tr><td>Cotton</td><td style="text-align: center;">4.5</td></tr> <tr><td>Acetate</td><td style="text-align: center;">4.5</td></tr> </table>	Wool	4.5	Acrylic	4.5	Polyester	4.5	Nylon	4.5	Cotton	4.5	Acetate	4.5
Wool	4.5														
Acrylic	4.5														
Polyester	4.5														
Nylon	4.5														
Cotton	4.5														
Acetate	4.5														
Grading of color change			4												




3.8.6 Viscose Color Fastness to Saliva Test Report (Bleaching Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:		Color Name:	Red
GSM:	160	Fabrication:	100% Viscose
Date:	10/12/24	Light Source:	D65

COLOR FASTNESS TO SALIVA GB/T18886: 2019

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td>4-5</td></tr> <tr><td>Acrylic</td><td>4-5</td></tr> <tr><td>Polyester</td><td>4-5</td></tr> <tr><td>Nylon</td><td>4-5</td></tr> <tr><td>Cotton</td><td>3-4</td></tr> <tr><td>Acetate</td><td>4-5</td></tr> </table>	Wool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	3-4	Acetate	4-5
Wool	4-5														
Acrylic	4-5														
Polyester	4-5														
Nylon	4-5														
Cotton	3-4														
Acetate	4-5														
Grading of color change			4												




3.8.7 Viscose Color Fastness to Saliva Test Report (Enzyme Water)

APEX Textile Testing Lab-QA: 501, V-I, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% cotton</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO SALIVA GB/T18886: 2019

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4.5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>3</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4.5</i></td></tr> </table>	Wool	<i>4.5</i>	Acrylic	<i>4.5</i>	Polyester	<i>4.5</i>	Nylon	<i>4.5</i>	Cotton	<i>3</i>	Acetate	<i>4.5</i>
Wool	<i>4.5</i>														
Acrylic	<i>4.5</i>														
Polyester	<i>4.5</i>														
Nylon	<i>4.5</i>														
Cotton	<i>3</i>														
Acetate	<i>4.5</i>														
Grading of color change			<i>3.4</i>												




3.8.8 Viscose Color Fastness to Saliva Test Report (Fixing Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO SALIVA GB/T18886: 2019

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> </table>	Wool	<i>4-5</i>	Acrylic	<i>4-5</i>	Polyester	<i>4-5</i>	Nylon	<i>4-5</i>	Cotton	<i>4-5</i>	Acetate	<i>4-5</i>
Wool	<i>4-5</i>														
Acrylic	<i>4-5</i>														
Polyester	<i>4-5</i>														
Nylon	<i>4-5</i>														
Cotton	<i>4-5</i>														
Acetate	<i>4-5</i>														
Grading of color change			<i>4</i>												

3.9 Color Fastness to Dye Transfer in Storage (AATCC 163)

3.9.1 Scope:

To ascertain the AATCC's guidelines for dye transfer resistance in storage [12]

3.9.2 Equipment:

- The perspiration meter
- A polyethylene plastic bag big enough to fit the perspiration meter
- Adjacent multifiber fabric, type DW (ISO 105-F10)
- Grade 3 distilled water
- A glass beaker that can hold fifty millilitres of water
- D65 light source in a light box
- Colour shift is measured using a grey scale (ISO 105-A02).
- Staining evaluation using a grey scale (ISO 105-A03)
- Fabric Sample

3.9.3 Working Procedure

For each sample to be analysed, cut specimens that are 4 cm by 10 cm.



Cut the fabric and multifiber samples to the same size.



At room temperature (24 ± 3)°C, submerge the fabric sample and multifiber in distilled water.



Sandwich the test specimen between the pre-wet fabric sample and the pre-wet multifiber. View the image below.

Each specimen should be placed in the perspirometer between two glass or acrylic plates. A maximum of 10 samples can be stored in each perspirometer. Even if there are fewer, the perspirometer still requires all 11 plates. Using the load, set the perspirometer's pressure to 12.5 kPa, lock it, and then take it off.



To keep the polyethylene bag's relative humidity high, place the perspirometer inside it and place a glass beaker filled with at least 50 millilitres of distilled water inside.



For seventy-two hours, leave the perspirometer upright in an oven set to 60°C.



Remove the samples from the perspiration tester. Each specimen should be opened out and thoroughly dried, with the specimen only touching the stitching point.

3.9.4 Viscose Color Fastness to Dye Transfer in Storage Test Report (Soft Water)

APEX Textile Testing Lab-GH-501, V. I, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% Viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO DYE TRANSFER IN STORAGE AATCC 163:2020

Before Test Specimen	Before Test Multifiber	After Test Multifiber &	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;">4-5</td></tr> <tr><td>Acrylic</td><td style="text-align: center;">4-5</td></tr> <tr><td>Polyester</td><td style="text-align: center;">4-5</td></tr> <tr><td>Nylon</td><td style="text-align: center;">4-5</td></tr> <tr><td>Cotton</td><td style="text-align: center;">4</td></tr> <tr><td>Acetate</td><td style="text-align: center;">4-5</td></tr> </table>	Wool	4-5	Acrylic	4-5	Polyester	4-5	Nylon	4-5	Cotton	4	Acetate	4-5
Wool	4-5														
Acrylic	4-5														
Polyester	4-5														
Nylon	4-5														
Cotton	4														
Acetate	4-5														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Grading of color change Fabric Sample & Specimen</td> <td style="text-align: center; vertical-align: middle;">2</td> </tr> </table>	Grading of color change Fabric Sample & Specimen	2										
Grading of color change Fabric Sample & Specimen	2														



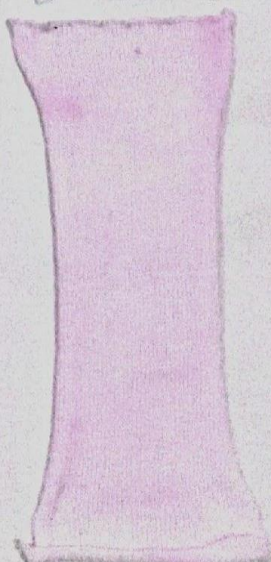
3.9.5 Viscose Color Fastness to Dye Transfer in Storage Test Report (Bleaching Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% Viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO DYE TRANSFER IN STORAGE AATCC 163:2020

Before Test Specimen	Before Test Multifiber	After Test Multifiber &	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>3-4</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> </table>	Wool	<i>4-5</i>	Acrylic	<i>4-5</i>	Polyester	<i>4-5</i>	Nylon	<i>4-5</i>	Cotton	<i>3-4</i>	Acetate	<i>4-5</i>
Wool	<i>4-5</i>														
Acrylic	<i>4-5</i>														
Polyester	<i>4-5</i>														
Nylon	<i>4-5</i>														
Cotton	<i>3-4</i>														
Acetate	<i>4-5</i>														
After Test Fabric Sample			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Grading of color change Fabric Sample & Specimen</td> <td style="text-align: center; vertical-align: middle;"><i>2-3</i></td> </tr> </table>	Grading of color change Fabric Sample & Specimen	<i>2-3</i>										
Grading of color change Fabric Sample & Specimen	<i>2-3</i>														

3.9.6 Viscose Color Fastness to Dye Transfer in Storage Test Report (Enzyme Water)

APEX Textile Testing Lab-QA: 501, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% Viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO DYE TRANSFER IN STORAGE AATCC 163:2020

Before Test Specimen	Before Test Multifiber	After Test Multifiber &	Grading												
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Wool</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Acrylic</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Polyester</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Nylon</td><td style="text-align: center;"><i>4-5</i></td></tr> <tr><td>Cotton</td><td style="text-align: center;"><i>3-4</i></td></tr> <tr><td>Acetate</td><td style="text-align: center;"><i>4-5</i></td></tr> </table>	Wool	<i>4-5</i>	Acrylic	<i>4-5</i>	Polyester	<i>4-5</i>	Nylon	<i>4-5</i>	Cotton	<i>3-4</i>	Acetate	<i>4-5</i>
Wool	<i>4-5</i>														
Acrylic	<i>4-5</i>														
Polyester	<i>4-5</i>														
Nylon	<i>4-5</i>														
Cotton	<i>3-4</i>														
Acetate	<i>4-5</i>														
			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Grading of color change Fabric Sample & Specimen</td> <td style="text-align: center; vertical-align: middle;"><i>3</i></td> </tr> </table>	Grading of color change Fabric Sample & Specimen	<i>3</i>										
Grading of color change Fabric Sample & Specimen	<i>3</i>														

3.9.7 Viscose Color Fastness to Dye Transfer in Storage Test Report (Fixing Water)

APEX Textile Testing Lab-001-301, V-1, Page-001

EXHIBIT TESTED SPECIMEN

Test Report No:		Original Swatch-Color	
Buyer:	Color Name: <i>Red</i>		
GSM: <i>160</i>	Fabrication: <i>100% Viscose</i>		
Date: <i>10/12/24</i>	Light Source: <i>D65</i>		

COLOR FASTNESS TO DYE TRANSFER IN STORAGE AATCC 163-2020

Before Test Specimen	Before Test Multifiber	After Test Multifiber &	Grading
			Wool <i>4-5</i>
			Acrylic <i>4-5</i>
			Polyester <i>4-5</i>
			Nylon <i>4-5</i>
			Cotton <i>4</i>
			Acetate <i>4-5</i>
	After Test Fabric Sample		
			Grading of color changes Fabric Sample & Specimen <i>3</i>

4.0 Hydraulic method for determination of bursting strength and bursting distension (ISO 13938-1:2019)

4.1.1 Scope:

This paper outlines a hydraulic technique for figuring out textile textiles' bursting strength and bursting distension.

4.1.2 Apparatus:

Bursting tester:

- ❖ Within $\pm 10\%$ of the specified value, the device must be able to generate a range of consistent volume growth rates per unit of time, from 100 cm³/min to 500 cm³/min. It is possible to use a testing time to burst of 20 ± 5 s if the device lacks the ability to alter fluid volume. The test report will make note of this.
- ❖ Above the first 20% of the range, the bursting pressure must be shown with an accuracy of $\pm 2\%$ of the full-scale range.
- ❖ An accuracy of ± 1 mm must be used to indicate height at burst up to 70 mm. The measuring gauge's zero position must be movable to account for the test specimen's thickness.
- ❖ methods for displaying the volume at burst within $\pm 2\%$ of the value that is displayed.
- ❖ 50 cm² will be the test area.
- ❖ If the intended test area cannot be used with the testing equipment currently in use, or if the fabric has high or low expansion or other fabric requirements, or if both parties agree, alternative test areas measuring 100 cm² (112,8 mm diameter), 10 cm² (35,7 mm diameter), or 7.3 cm² (30,5 mm diameter) may be used.
- ❖ In addition to preventing slippage throughout the test, the clamping mechanism must enable the test specimen to be clamped securely without distortion or damage. The clamping ring must permit extraordinarily expansive fabrics to vault without interference. The inner diameters of all test specimen clamping rings must be precise to within ± 0.2 mm. It is advised that the inner edge of the clamping ring facing the test specimen have a slight curve to prevent harm to the specimen.

4.1.3 The diaphragm shall meet the following requirements

If the diaphragm is to be used repeatedly, its thickness up to 2 mm must be extremely expansive; additionally, it must be elastic throughout the range of height at burst seen during the test and resistant to the pressurising fluids utilised.

4.1.4 Atmospheres for conditioning and testing

The preconditioning, conditioning, and testing atmospheres must meet ISO 139 requirements.

4.1.5 Working Procedure:

According to Clause 7, the sample must be conditioned in the relaxed state before testing. According to Clause 7, keep the test specimens in the atmosphere while they are being conditioned and tested.



The 50 cm² test area is appropriate for the majority of materials, especially knitted fabrics. For textiles that are not very extensible



Depending on the test area and fabric requirements, set a steady rate of volume growth of 100–500 cm³/min. If a consistent rate of volume growth is not applicable, then use preliminary experiments to determine a time to distend a test specimen to burst of $(20 \pm 5 \text{ s})$.



To prevent distortion in its own plane, position the test specimen over the diaphragm such that it sits flat and tension-free. After putting the distension recording device in the measuring position, set it to zero. Secure the safety cover in place in accordance with the specifications of the machine.

4.1.6 Diaphragm correction

Distend the diaphragm without a test specimen present by an amount equal to the mean height at burst or the mean volume at burst of the test specimen, using the same test area, rate of volume rise, or time to burst as used in the aforementioned tests. The pressure at this diaphragm distension is referred to as the "diaphragm pressure."

5.0 Determination of pH of aqueous extract (ISO 3071)

5.1 Scope:

This article outlines a procedure for figuring out the textile aqueous extract's pH. The technique works with textiles of any type, including fibres, yarns, and fabrics.

5.1.1 Reagents:

Distilled or deionized water: At least grade 3 distilled or deionised water with a pH of 5.0 to 7.5

Potassium chloride solution: 0,1 mol/l, made with deionised or distilled water

Buffer solutions: possessing a pH that is comparable to the one being measured, in order to calibrate the pH meter before to measurement. It is advised to use buffer solutions with a pH of 4, 7, or 9.

5.1.2 Apparatus:

Stoppered glass or polypropylene flasks: resistant to chemicals, in order to prepare the aqueous extract. It is advised that the glassware used for this test be reserved only for this application.

Mechanical shaker: allowing for enough rotating or reciprocating movement to ensure a quick liquid exchange between the textile material's interior and the extract preparation solution. It has been determined that a 60 r/min to-and-fro movement or a 30 r/min rotational frequency is enough.

Beakers: chemically impervious, 150 ml capacity

Rods: resistant to chemicals.

pH- meter: has a resolution of at least 0.01 pH units and a glass electrode. It is advised to use a pH meter with temperature compensation.

Balance: with a minimum 0.01 g resolution.

1L volumetric flasks: of superior quality.

5.1.3 Preparation of test specimens:

Slice the lab test sample into pieces that are about 5 mm across or large enough to let the test specimens wet out quickly. Handle the substance as little as possible to prevent contamination. Take two test specimens weighing $2,00 \pm 0.05$ g each from the laboratory test sample.

5.1.4 Working Procedure

Preparation of the aqueous extract

Fill a stoppered flask with 100 ml of the extracting solution (potassium chloride solution) and each test specimen. To make sure the textile material is adequately wetted out, agitate the flask by hand for a brief length of time. Then, shake it mechanically for two hours and five minutes.

Measurement of the pH of the aqueous extract

- ❖ Take note of the extracting solution's temperature. Set up the pH meter and use two buffer solutions to verify that it is calibrated.
- ❖ Until the desired pH value stabilises, submerge the electrode many times in the KCl solution used to prepare the extract.
- ❖ Before recording the pH value of this solution, decant a portion of the initial extract into a beaker, instantly submerge the electrode to a minimum depth of 10 mm, and gently stir with a rod until the pH value stabilises.
- ❖ Decant the remainder first into a different beaker. Then, without cleaning, submerge the electrode in the beaker to a minimum depth of 10 mm. Let it stand without stirring until the pH value stabilises. As the initial measurement, note this value.
- ❖ After decanting the second extract into a different beaker, immediately submerge the electrode—without cleaning—to a minimum of 10 mm in the beaker and leave it there without stirring until the pH level stabilises. This value should be noted as the second measurement.

5.1.5 Calculation:

Repeat the process with additional test specimens if the difference between the two pH readings, expressed to the nearest 0.1 pH units, is larger than 0.2. Determine the mean value when two reliable measurements have been taken.

CHAPTER-4
DISCUSSION OF RESULTS

4.0 Viscose Dyeing Swatch Card

Akzochem Industries (BD) Ltd. Customer Color Approval

Party:		
Date 8-Dec-24	4:17 PM	Light Source : D65
Dyeing Method : 8	LAB DIP NO.	
Fabrication :	100% Viscose S/J	Color Name : Red

Color Sample (Produces by Akzochem)



Soft Water

Bleaching

Enzyme

Lot# 596	Argazol Orange EXD →	0.62 %
Lot# 571	Argazol D. Red EXD →	2.12 %
Lot# 226	Remazol Bri. Blue BB →	0.0218 %
	Glauber Salt →	60 g/L
	Soda Ash →	15 g/L
	M1 →	1:10



Fixing

Sign. Customer

Sign. Akzochem Industries (BD) Ltd.

4.1.1 Viscose Dyeing CMC Report (Soft Water)

Bengal Hurricane Dyeing & Printing (Pvt.) Ltd.

Standard Name: 176 of 176 Today's Date: 08-Dec-24 **datacolor**
The Right Color - from Mind to Market

Red 100% Viscose S/J

Standard: 10767 600 %R LAV SCI UV 400

Batch Name: 2 of 2

Soft Water1

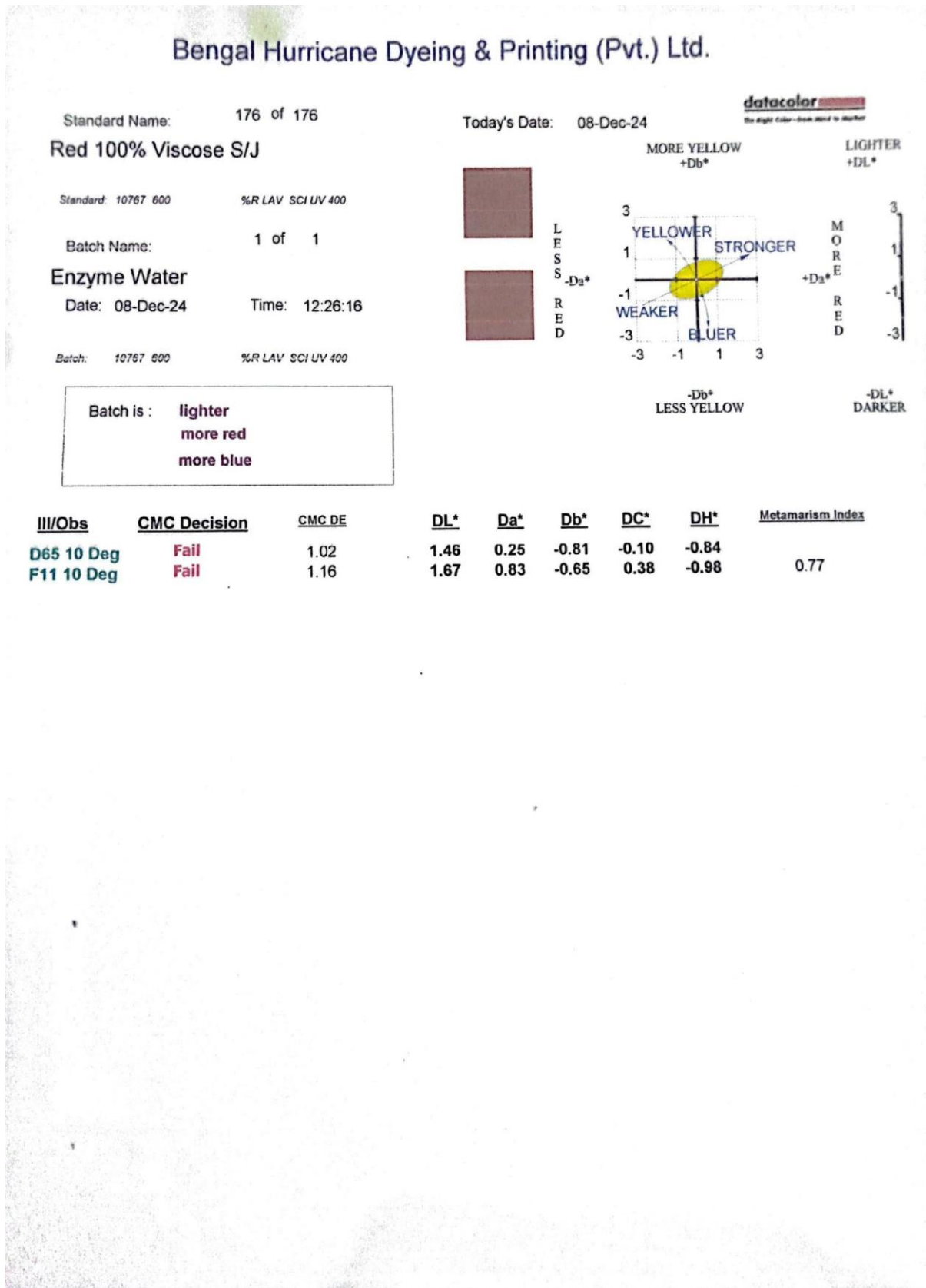
Date: 08-Dec-24 Time: 12:27:34

Batch: 10767 600 %R LAV SCI UV 400

Batch is : **lighter**
more red
more blue

<u>III/Obs</u>	<u>CMC Decision</u>	<u>CMC DE</u>	<u>DL*</u>	<u>Da*</u>	<u>Db*</u>	<u>DC*</u>	<u>DH*</u>	<u>Metamerism Index</u>
D65 10 Deg	Pass	0.42	0.66	0.15	-0.21	0.05	-0.25	
F11 10 Deg	Pass	0.43	0.72	0.29	-0.10	0.20	-0.23	0.24

4.1.2 Viscose Dyeing CMC Report (Enzyme Water)



4.1.3 Viscose Dyeing CMC Report (Belching Water)

Bengal Hurricane Dyeing & Printing (Pvt.) Ltd.

Standard Name: 176 of 176

Today's Date: 08-Dec-24

datacolor
The Right Color - from Mind to Market

Red 100% Viscose S/J

Standard: 10767 600 %R LAV SCI UV 400

Batch Name: 5 of 5

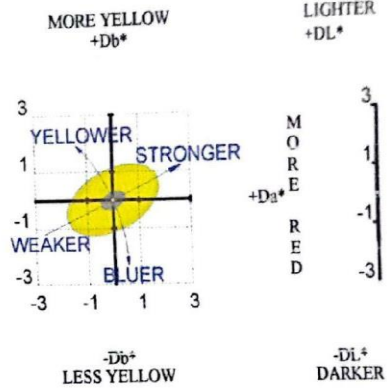
Bleaching water

Date: 08-Dec-24 Time: 12:31:10

Batch: 10767 600 %R LAV SCI UV 400



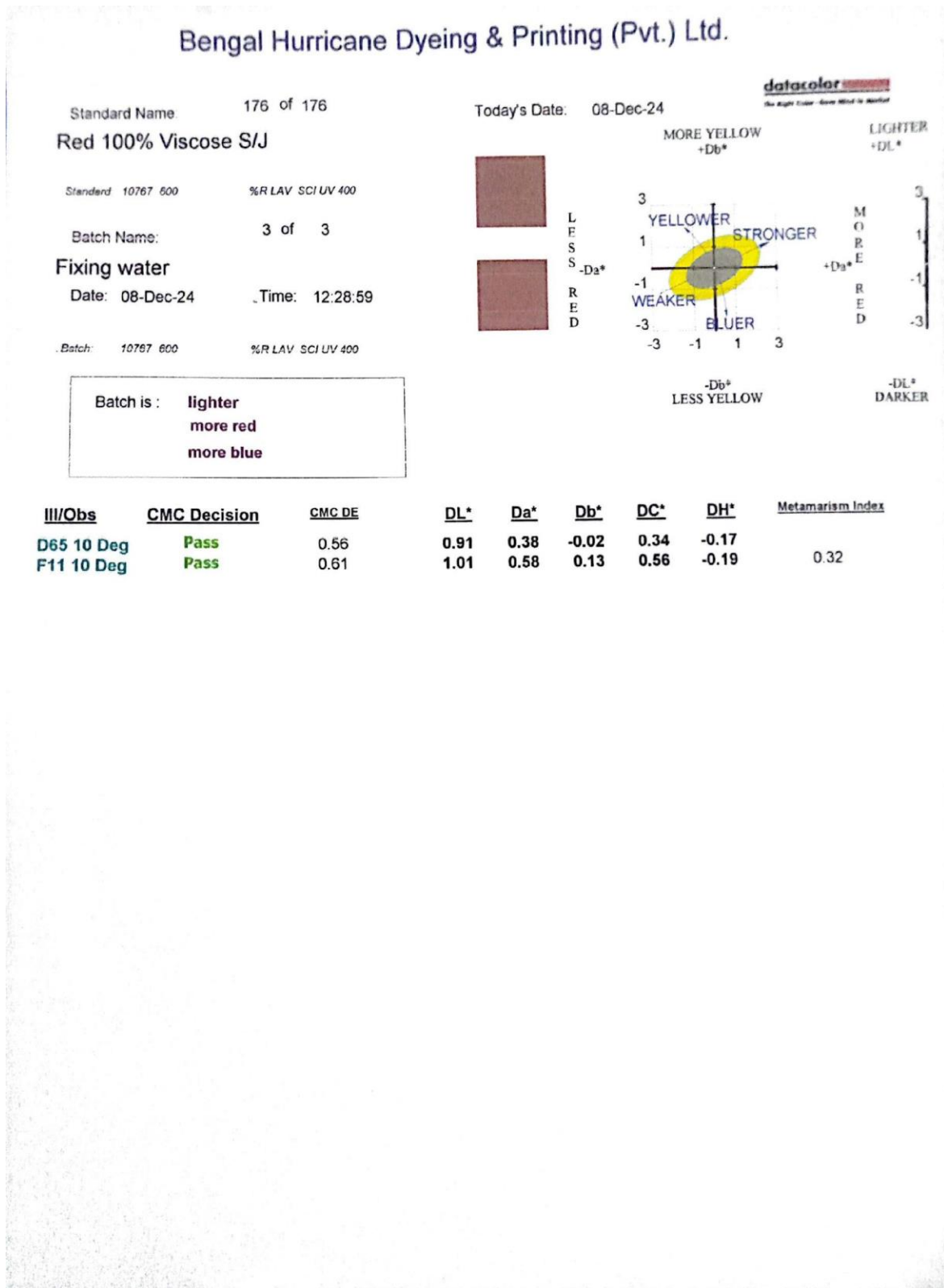
L
E
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S
-D_a*
R
E
D



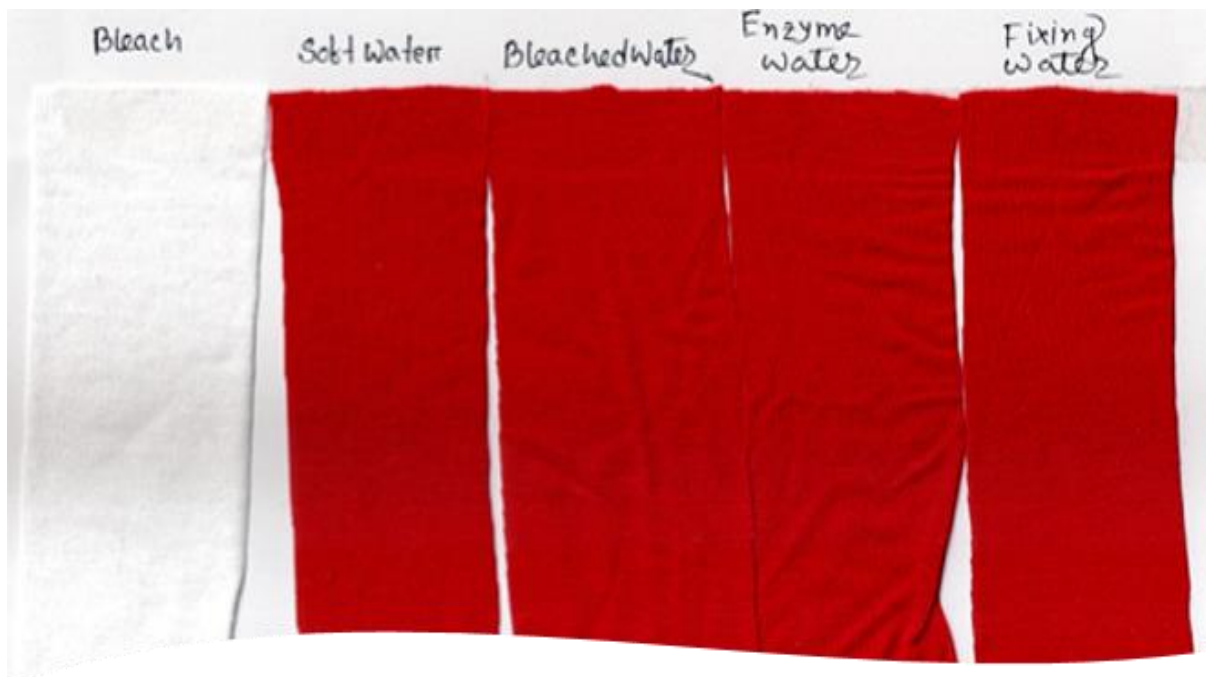
Batch is : **lighter**
more red
more blue

III/Obs	CMC Decision	CMC DE	DL*	Da*	Db*	DC*	DH*	Metamerism Index
D65 10 Deg	Warn	0.95	1.24	0.00	-1.01	-0.40	-0.92	0.69
F11 10 Deg	Warn	0.98	1.42	0.48	-0.68	0.06	-0.83	

4.1.4 Viscose Dyeing CMC Report (Fixing Water)



4.1.5 Different Stages of Viscose Dyeing Fabric Shade by 4 layers of water.



Pure viscose fabric was used for this project, and a variety of different water sources were chosen, such as soft water from the regular supply, bleaching water, enzyme water, and fixing water for dyeing with the same shade %. In the case of fastness properties—wash, water, rubbing, perspiration, and light—no discernible differences are detected. Bleach water was superior to others when colour difference and metamerism were taken into account; the same was true for colour strength. It is obvious that those kinds of untreated wastewater might be utilised in our wet processing treatment, which could have positive effects on the environment and the economy.

4.1.6 Difference of Viscose Color Fastness to Rubbing Test Results

Dyeing	Soft Water	Bleaching Water	Enzyme Water	Fixing Water
Dry Rubbing (Face Side)	4	4	4	4
Wet Rubbing (Face Side)	2	2-3	2	3
Dry Rubbing (Back Side)	4	4	4	4
Wet Rubbing (Back Side)	2	2	2-3	3

4.1.7 Difference of Color Fastness to Wash Test Results

Reusing water	Multifiber						color change
	Acetate	Cotton	Nylon	Polyester	Acrylic	Wool	
Soft water	4-5	4-5	4-5	4-5	4-5	4-5	4
Bleaching	4-5	2-3	4-5	4-5	4-5	4-5	3-4
Enzyme	4-5	3	4-5	4-5	4-5	4-5	4-5
Fixing	4-5	4	4-5	4-5	4-5	4-5	4

4.1.8 Difference of Color Fastness to Water Test Results

Reusing water	Multifiber						color change
	Acetate	Cotton	Nylon	Polyester	Acrylic	WOOL	
Soft water	4-5	4-5	4-5	4-5	4-5	4-5	4
Bleaching	4-5	4-5	4-5	4-5	4-5	4-5	4
Enzyme	4-5	2-3	4	4-5	4	4-5	4
Fixing	4-5	3	4-5	4-5	4-5	4-5	4

4.1.9 Difference of Color Fastness to Acid & Alkaline Test Results

Reusing water	Perspiration	Multifiber						color change
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool	
Soft water	Acidic	4-5	4-5	4-5	4-5	4-5	4-5	4
	Alkaline	4-5	4-5	4-5	4-5	4-5	4-5	4
Bleaching	Acidic	4-5	4	4-5	4-5	4-5	4-5	4
	Alkaline	4-5	4-5	4-5	4-5	4-5	4-5	4
Enzyme	Acidic	4-5	3	4-5	4-5	4-5	4-5	4
	Alkaline	4-5	2-3	4	4-5	4	4	4
Fixing	Acidic	4-5	4-5	4-5	4-5	4-5	4-5	4
	Alkaline	4-5	4-5	4-5	4-5	4-5	4-5	4

4.2 Difference of Color Fastness to Household Laundering Test Results

Reusing water	Multifiber						Color change
	Acetate	Cotton	Nylon	Polyester	Acrylic	Wool	
Soft water	4-5	4-5	4-5	4-5	4-5	4-5	4
Bleaching	4-5	3	4-5	4-5	4-5	4-5	4
Enzyme	4-5	3	4-5	4-5	4-5	4-5	4
Fixing	4-5	4-5	4-5	4-5	4-5	4-5	4

4.2.1 Difference of Color Fastness to Saliva Test Results

Reusing water	Multifiber						Color change
	Acetate	Cotton	Nylon	Polyester	Acrylic	Wool	
Soft water	4-5	4-5	4-5	4-5	4-5	4-5	4
Bleaching	4-5	3-4	4-5	4-5	4-5	4-5	4
Enzyme	4-5	3	4-5	4-5	4-5	4-5	4
Fixing	4-5	4-5	4-5	4-5	4-5	4-5	4

4.2.2 Difference of Color Fastness to Dye Transfer in Storage Test Results

Reusing water	Multifiber						Color change
	Acetate	Cotton	Nylon	Polyester	Acrylic	Wool	
Soft water	4-5	4	4-5	4-5	4-5	4-5	2
Bleaching	4-5	3-4	4-5	4-5	4-5	4-5	2-3
Enzyme	4-5	3-4	4-5	4-5	4-5	4-5	3
Fixing	4-5	4	4-5	4-5	4-5	4-5	3

4.2.3 Bursting Strength Test Results

James Heal - TruBurst Results

ISO 13938-2 2019

Bursting Properties of Fabrics-Part 2

ESSENTIAL

FB-2401405 BATCH-80001

Temperature: 20 °C

Relative Humidity: 65%

Weight: 0

NTests: 3 / 3

Diaphragm: 1.0mm

Test Area: 50cm² (79.8mm Dia)

Inflation Rate: 8kPa/s

Correction Rate: 3kPa/s

Burst Detect: Normal

Clamp Pressure: 575 kPa

Target Pressure: 0kPa

Target Distension: 0.0mm

Results - Corrected Test	kPa	mm	s
1	148.2	20.7	21.9
2	145.3	20.0	21.5
3	145.1	19.3	21.4
Mean	146.2	20.0	21.6
Q95	4.4	1.8	0.6
Q95 Max	150.6	21.8	22.2
Q95 Min	141.8	18.2	21.0
CV%	1.2	3.7	1.1

Diaphragm Correction: 24.4kPa

Instrument Model: 1440

Instrument Serial: 1440/20/1234

Software Version: 2.0.3.0

Hardware Version: V1.21

4.2.4 pH-value of (Soft Water)

Slop %	Value	Diffrence	Result
94%	7.49	0.02	7.5
94%	7.51	0.02	

4.2.5 pH-value of (Enzyme Water)

Slop %	Value	Diffrence	Result
95%	5.55	0.02	5.56
95%	5.57	0.02	

4.2.6 pH-value of (Bleaching Water)

Slop %	Value	Diffrence	Result
94%	8.50	0.01	8.50
94%	8.51	0.01	

4.2.7 pH-value of (Fixing Water)

Slop %	Value	Diffrence	Result
96%	7.53	0.02	

96%	7.55	0.02	7.54
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CHAPTER-5
CONCLUSION

Conclusion:

Pure viscose fabric was used for this project, and a variety of different water sources were chosen, such as soft water from the regular supply, bleaching water, enzyme water, and fixing water for dyeing with the same shade %. When it comes to the fastness properties—wash, water, rubbing, and perspiration—no discernible differences are detected. Bleach water was superior to others when colour difference and metamerism were taken into account; the same was true for colour strength. These kinds of untreated wastewater can obviously be utilised in our wet processing treatment, which could have positive effects on the environment and the economy.

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