Faculty of Engineering

Department of Textile

Engineering

Course Code: TH-519

Course Title: Reuse of Discharged Liquor for Polyester Dyeing

Project (M.Sc. In Textile Engineering)

Submitted By:	ID:	Supervised By:
Md Kayam Uddin	213-32-006	Mr. Tanvir Ahmed Chowdhury Head of the Department Department of Textile Engineering

A thesis submitted in partial fulfillment of the requirement for the degree

Of Master of Science in Textile Engineering.

LETTER OF APPROVAL

January 08, 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 213-32-006** has finished the project report, "**Reuse of Discharged Liquor for Polyester 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

Had 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. Kayam Uddin

ID: 213-32-006

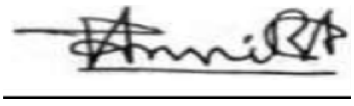
Department of Textile Engineering

Faculty of Engineering

Daffodil International University

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

Supervisor:



Mr. Tanvir Ahmed Chowdhury

Had of the Department

Department of Textile Engineering

Faculty of Engineering

ACKNOWLEDGEMENT

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.

My supervisor's extensive expertise and keen interest in textiles motivated me to complete the thesis. The completion of this thesis has been made possible by their unending patience, academic assistance, unceasing support, enthusiastic supervision, constructive criticism, insightful counsel, reading numerous subpar drafts, and fixing them at every turn.

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

The qualities of polyester fibre that are revealed following disperse dyeing are the main focus of this thesis. This thesis compares several kinds of attributes. I will start by dying a polyester sample cloth in a sample dyeing pot. Once the dyeing process is finished, we will take a sample from the dyeing pot. There will be some dye solution left over at this point, so I'll dye it again using a fresh sample of fabric. I will then review the CMC report. In a similar manner, I will dye a sample of polyester fabric. Following dyeing, the fabrics display a variety of tints. I can compare this shade in a different way based on visual evaluation.This thesis examines the properties of polyester fabric, including its colourfastness to rubbing, colourfastness to washing, colourfastness to water, colourfastness to saliva, colourfastness to sweat, colourfastness to dye transfer, colourfastness to phenolic yellowing, pH value, and bursting strength. Check the CMC report as well.

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CHAPTER 01
INTRODUCTION

1.1 Background of the study

Disperse dyes background:

Polyester fibre dyeing is the primary use for disperse dye. While dyestuff is mostly suspended in dye liquid with minute microparticulates in water, dispersion dye is insoluble in water. A significant amount of anionic dispersing agents is added to commercial dye to ensure the stability of the dispersed dye liquid. Consequently, it is not recommended to add a cationic auxiliary agent to dye solution. Disperse dyes have a different structure and stability than soda acid. various PH dye liquors frequently result in various colouration outcomes and have an impact on the dry sack depth. creates appearance and becoming. Disperse dyes are best stable in weakly acidic media. In an alkaline media with fast-base molecules and amide groups, the cyano group dyestuff is readily hydrolysed at high temperatures, changing its colour and sheen. Additionally, hydroxyl dyestuff under basic conditions or dyestuff including amino in molecules might cause ionisation in amino when the pH value is lower. increase the water-soluble amount of

1.2 Objective of the study

- to learn about the basic dyeing, re-dying solution, and testing concepts that are discussed in this thesis.
- Gaining knowledge about re-dying solutions and tests is the goal of this thesis.
- Before beginning this thesis process, familiarise yourself with the criteria to be identified.
- Get a firsthand grasp of the dyeing and testing preparation procedure.
- Learn the differences between the dyeing, re-dying, and test techniques.
- With on-test concepts, we will acquire a thorough comprehension of theoretical reactive dye and disperse dye.
- The development of practical and applied learning requires industrial training.

1.3 Significance of study

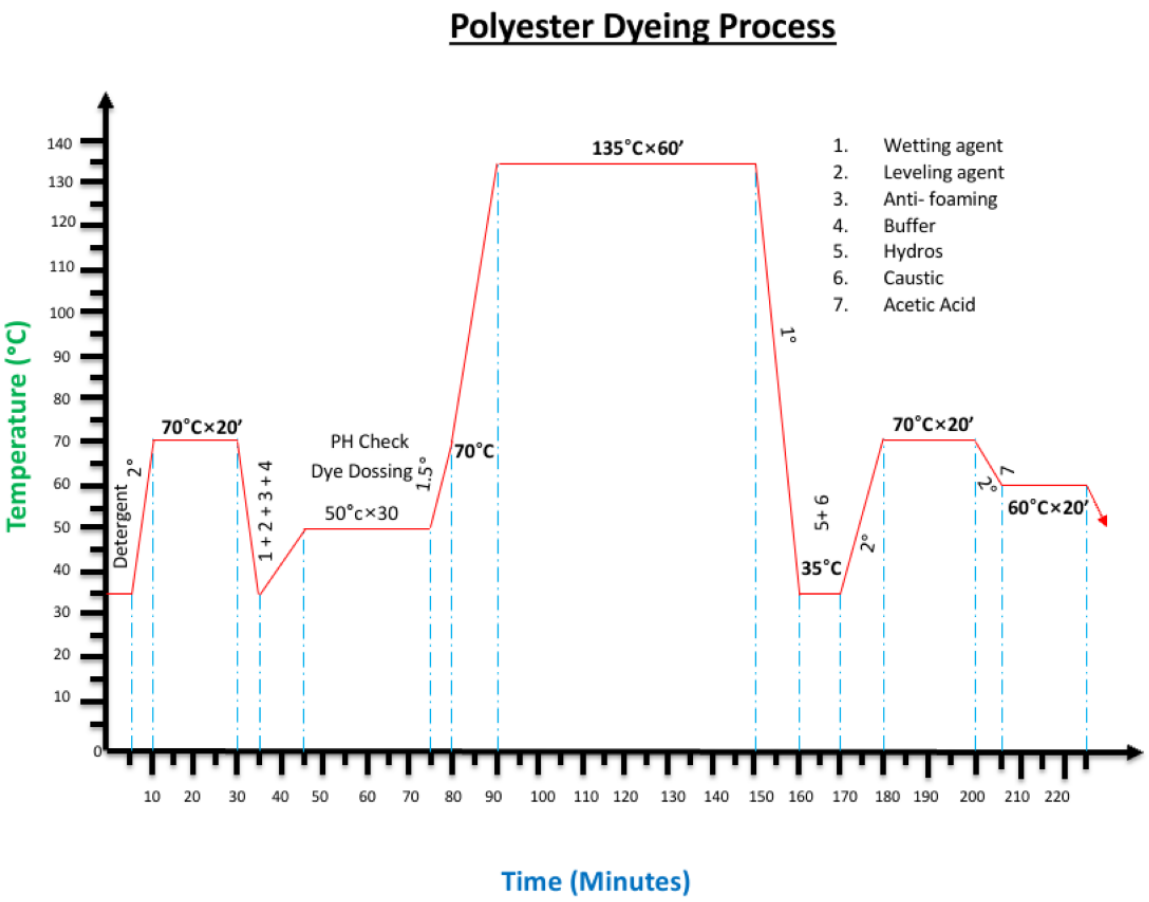
- Differentiate fabric testing aids in guaranteeing that goods fulfil the required criteria for quality.
- It enables producers to spot any flaws or problems early on in the manufacturing process.
- The physical characteristics of textiles, including their ability to retain colour during washing, water, 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

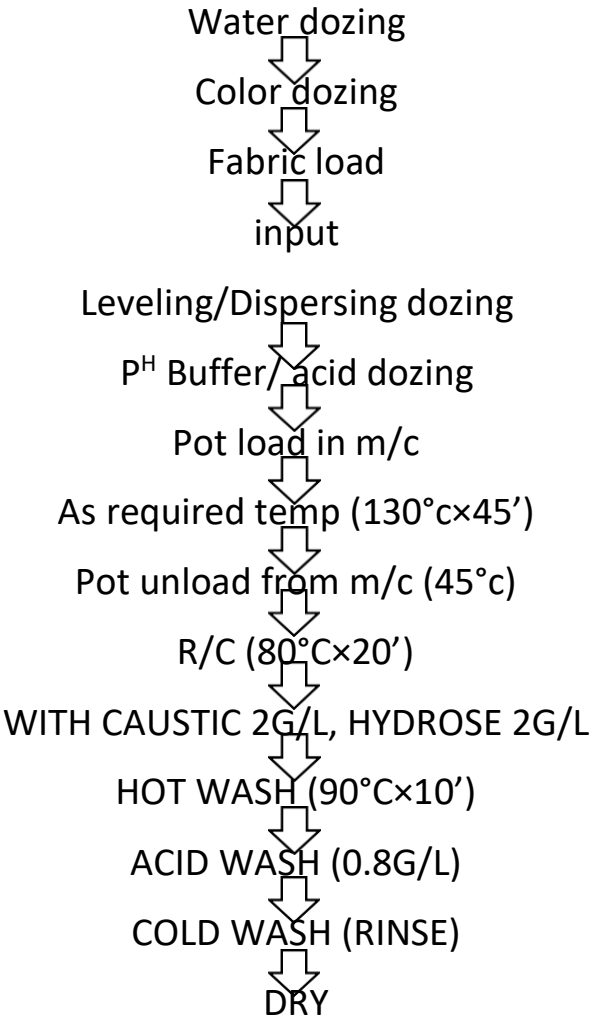
- Disperse dyes' primary disadvantage is that they must be used to guarantee the dye's fixation onto the fibre. A significant amount of inorganic electrolyte must be added, and the dyeing process must be conducted in an alkaline media.
- Because it is challenging to achieve excellent homogenisation, disperse dyes are challenging to utilise.
- Some disperse dyes have low washing fastness, especially for particularly deep colours, and it can be challenging to get dark hues. However, disperse dye has better coverage of barre than acid dye.
- Because they are non-toxic, disperse dyes don't affect the environment. They adhere to a number of environmental requirements and are free of heavy metals.

CHAPTER 02
LITERATURE REVIEW

2.1 Polyester Dyeing Process



2.1.2 POLYESTER DYEING WORKING PROCESS



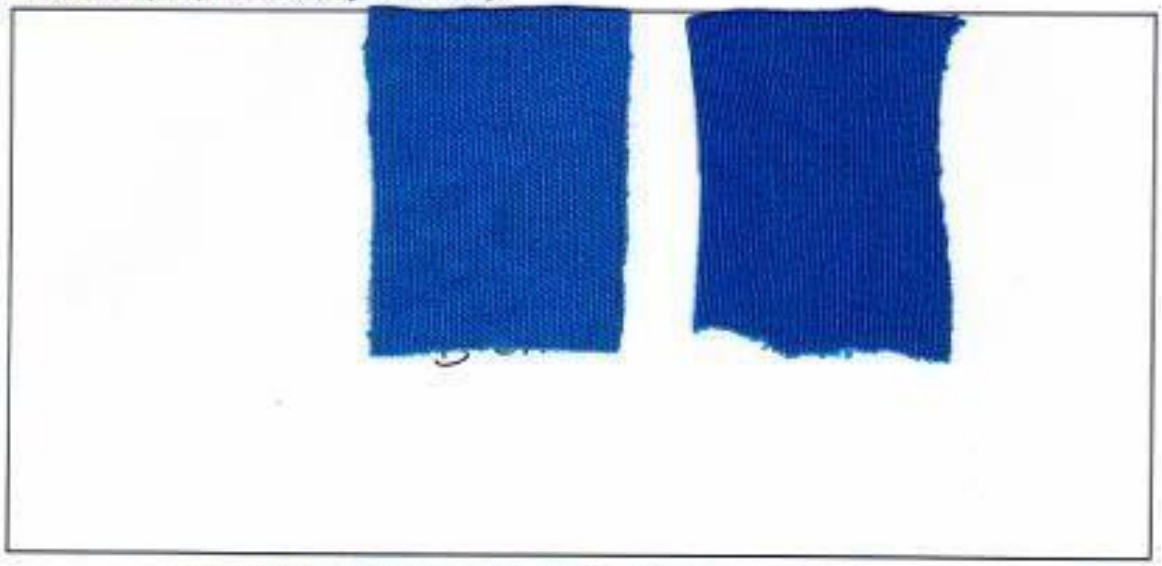
2.1.3 Polyester Dyeing Swatch Card

Akzo Chem Industries (BD) Ltd.

Customer Color Approval

Customer: AKZOchem Industries (BD) Ltd. Order No:- Adler	
Date: 04/07/24	AIBL Color Code: F-3034-24 (B)
Dyeing Process: 100% Polyester SHJ	Customer Color Code: 18-4141 TCX (Blue)

Color Sample (Produces by AIBL Ltd.) :



Flaperse Yellow HW WSP BS – 0.0010%
Lot = 107
Flaperse Blue SE 2R – 0.42%
Lot = 067
Flaperse Turquise Blue HW WSP SB – 0.44%
Setacid PBS – 0.5 g/L
Setalan DFT – 0.5 g/L
M:L = 1:10
pH = 4.3 ~ 4.5

Reduction:-
~~Re~~DNG clean pN-2.0g/L

Sign. Customer

Sign. Akzochem Industries (BD) Ltd.

CHAPTER 03
EXPERIMENTAL DETAIL

3.1 Colorfastness to Rubbing (ISO 105 X-12)

3.1.1 Scope:

to ascertain how resistant various textiles' colors—including floor coverings and other pile fabrics—are to fading and discolouring other materials.

3.1.2 Apparatus:

- Crock With a finger rubbing motion, 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)

3.1.3 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.

3.1.4 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.

3.1.5 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.

3.1.6 Evaluation:

- Each tested rubbing cloth should be covered with three layers of white rubbing cloth for evaluation.
- Under suitable lighting conditions, assess the stains on the cotton rubbing cloths using the grey scale.

3.1.7 Polyester (1st Time) Color Fastness to Rubbing Test Report

APEX Textile Testing

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

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (1st)	
GSM:	160	Fabrication:	100% P.S/J	
Date:		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 = 100%
Grading:	Grading: 4-5	Grading: 4-5	

Width Wise Rubbing Test:

Before Test Rubbing Cloth	Dry Rubbing (Back)	Wet Rubbing (Back)	Wet Pick Up = 92%
Grading:	Grading: 4-5	Grading: 4-5	

3.1.8 Polyester (2nd Time) Color Fastness to Rubbing Test Report

APEX Textile Testing

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

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue(2nd)	
GSM:	160	Fabrication:	P. SIJ	
Date:		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 = 100%
Grading:	Grading: 4-5	Grading: 4-5	

Width Wise Rubbing Test:

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

3.2 Colorfastness to Wash (ISO 105 C06 A02)

3.2.1 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.

3.2.2 Apparatus, materials, and reagent:

- 550ml stainless steel still container
- Still balls made of stainless (6mm)
- Machine Washcator ECE Formulation Reference phosphate (A) = 4g/L
- Sodium Perborate 1g/L
- Specimen 4 x 10 cm and Multifiber
- Water Incubator,
- Grade 3,
- Grey Scale, (ISO 105 A02 & ISO 105 A03)

3.2.3 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.

3.2.4 Polyester (1st Time) Color Fastness to Wash Test Report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (1st)	
GSM:	160	Fabrication:	100% P.S/J	
Date:		Light Source:	D65	

COLOR FASTNESS TO WASH ISO 105 C06 A2S:1987

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change:	4-5

3.2.5 Polyester (2nd Time) Color Fastness to Wash Test Report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (2nd)	
GSM:	160	Fabrication:	P. SJ	
Date:		Light Source:	D65	

COLOR FASTNESS TO WASH ISO 105 C06 A2S:1987

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

3.3 .0 Colorfastness to Water (ISO 105 E-01)

3.3.1 Scope:

to ascertain how resistant various types of coloured textiles are to submersion in water.

3.3.2 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)

3.3.3 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.

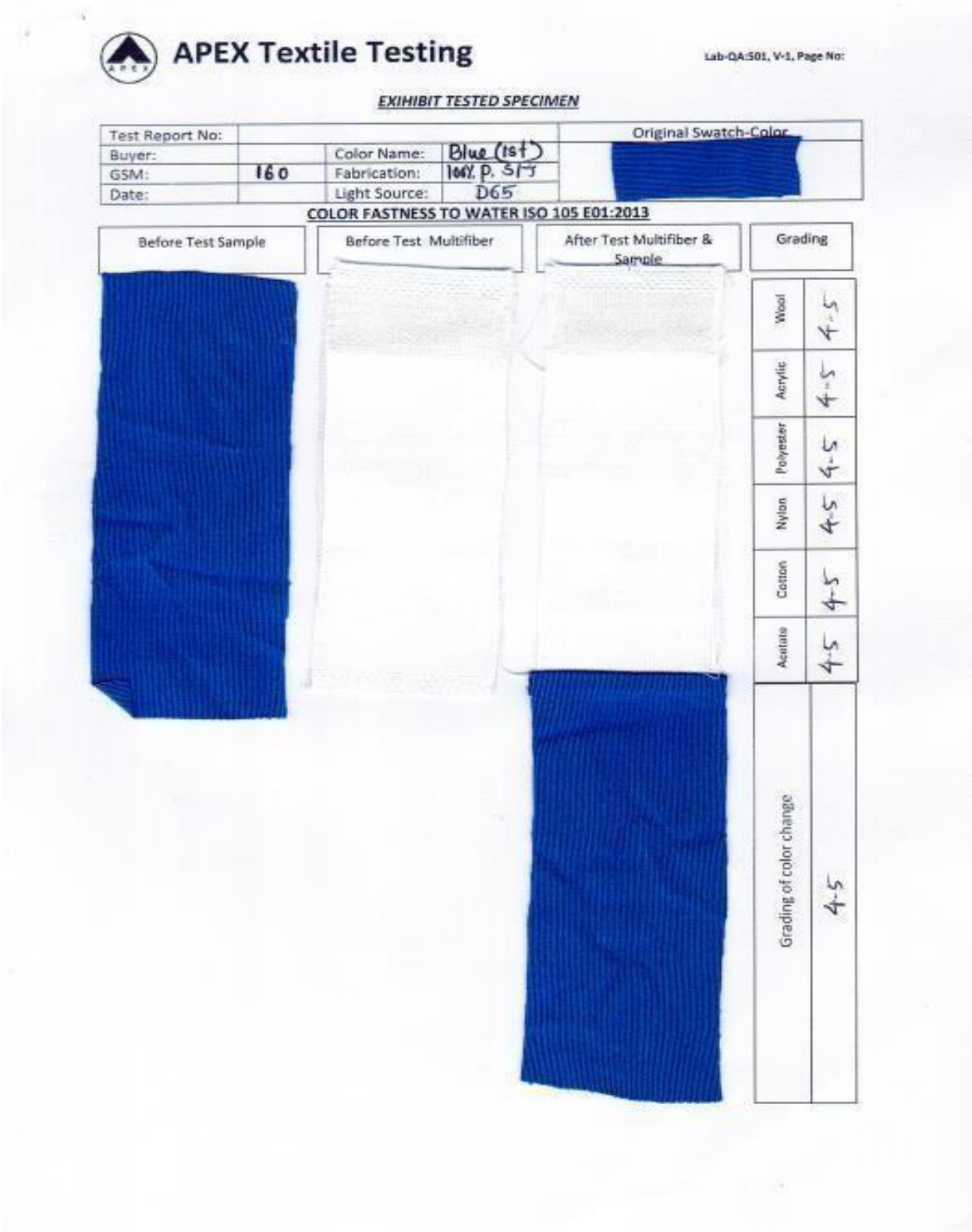
⇩

Dry at 60°C in an incubator.

⇩

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

3.3.4 Polyester (1st Time) Color Fastness to Water Test Report



APEX Textile Testing

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

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (1st)	
GSM:	160	Fabrication:	100% P. SJF	
Date:		Light Source:	D65	

COLOR FASTNESS TO WATER ISO 105 E01:2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

3.3.5 Polyester (2nd Time) Color Fastness to Water Test Report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (2nd)	
GSM:	160	Fabrication:	P- SJ	
Date:		Light Source:	D65	

COLOR FASTNESS TO WATER ISO 105 E01:2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

3.4 Color fastness to perspiration (ISO 105 E04)

3.4.1 Scope:

to ascertain how resistant the colour of fabrics of various types and forms is to the effects of perspiration from people.

3.4.2 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
- Grey Scale Perspiration Meter Incubator (ISO 105 A02 & ISO 105 A03)

3.4.3 Acid solution & Alkaline solution

3.4.4 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).

3.4.5 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).

3.4.6 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. The Perspiro meter should be dried in an incubator at 60°C after being placed in an oven at 37°C for four hours.

⇩

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

3.4.7 Polyester (1st Time) Perspiration (Acid) Test Report

APEX Textile Testing

Lab-QA:S01, V-1, Page No:

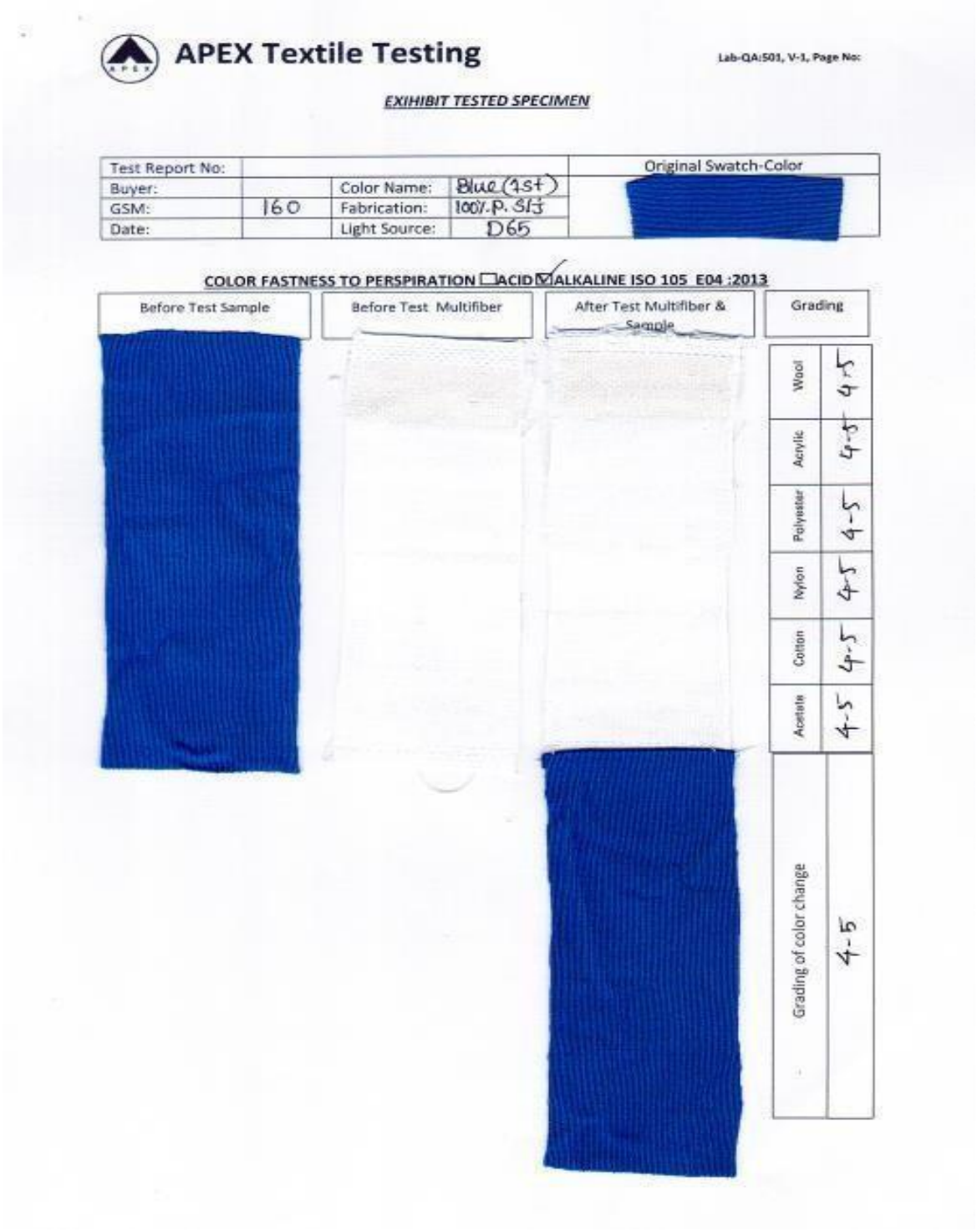
EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (1st)	
GSM:	160	Fabrication:	100% P. SJS	
Date:		Light Source:	D65	

COLOR FASTNESS TO PERSPIRATION ☑ ACID ☐ ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber &	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

3.4.8 Polyester (2nd Time) Perspiration (Alkaline) Test Report



APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (1st)	
GSM:	160	Fabrication:	100% P. Sft	
Date:		Light Source:	D65	

COLOR FASTNESS TO PERSPIRATION ☐ACID ☑ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

3.4.9 Polyester (2nd Time) Perspiration (Acid) Test Report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (2nd)	
GSM:	160	Fabrication:	P. S13	
Date:		Light Source:	D65	

COLOR FASTNESS TO PERSPIRATION ☑ ACID ☐ ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

3.5 Polyester (2nd Time) Perspiration (Alkaline) Test Report

APEX Textile Testing

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

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (2nd)	
GSM:	160	Fabrication:	P. S/J	
Date:		Light Source:	D65	

COLOR FASTNESS TO PERSPIRATION ☐ACID ☑ALKALINE ISO 105 E04 :2013

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

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

3.6.1 Scope:

Assess the textiles' colour fastness to domestic washing.

3.6.2 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

3.6.3 Working Procedure

Cut Multifiber 4×10cm

Use tag gun to attach multifiber to specimen

Fabric cutting for assessment

Wash according to care instruction

Multifiber should be dry in line and separately

Specimen dry according to care instruction

3.6.4 Polyester (1st Time) Color Fastness to Household Laundering Test Report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (1st)	
GSM:	160	Fabrication:	100% P. S/J	
Date:		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	4-5
			Acetate	4-5
			Grading of color change	4-5

3.6.5 Polyester (2nd Time) Color Fastness to Household Laundering Test Report

APEX Textile Testing

Lab-QA-S01, V-1, Page No:

EXHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue(2nd)	
GSM:	160	Fabrication:	P. Slj	
Date:		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	4-5
			Acetate	4-5
			Grading of color change	4-5

3.7 Color Fastness to Saliva (GB/TI 18886)

3.7.1 SCOPE:

to ascertain the fabrics' colour resistance to saliva in accordance with GB/T 18886.

3.7.2 Equipment:

- Perspirometer 11 glass or acrylic-resin plates
- Dishes with a flat bottom
- The oven is kept at (37±2)°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

3.7.3 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
- Xiadrate 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

3.7.4 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 60°C in an incubator.

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

3.7.5 Polyester (1st Time) Color Fastness to Saliva Test report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (1st)	
GSM:	160	Fabrication:	100% P. SJ	
Date:		Light Source:	D65	

COLOR FASTNESS TO SALIVA GB/T18886 :2019

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

3.7.6 Polyester (2nd Time) Color Fastness to Saliva Test report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (2nd)	
GSM:	160	Fabrication:	P. S/J	
Date:		Light Source:	D65	

COLOR FASTNESS TO SALIVA GB/T18886 :2019

Before Test Sample	Before Test Multifiber	After Test Multifiber & Sample	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5
			Grading of color change	4-5

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

3.8.1 SCOPE:

to ascertain the storage-related resistance to dye transfer in accordance with AATCC 163.

3.8.2 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

3.8.3 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.

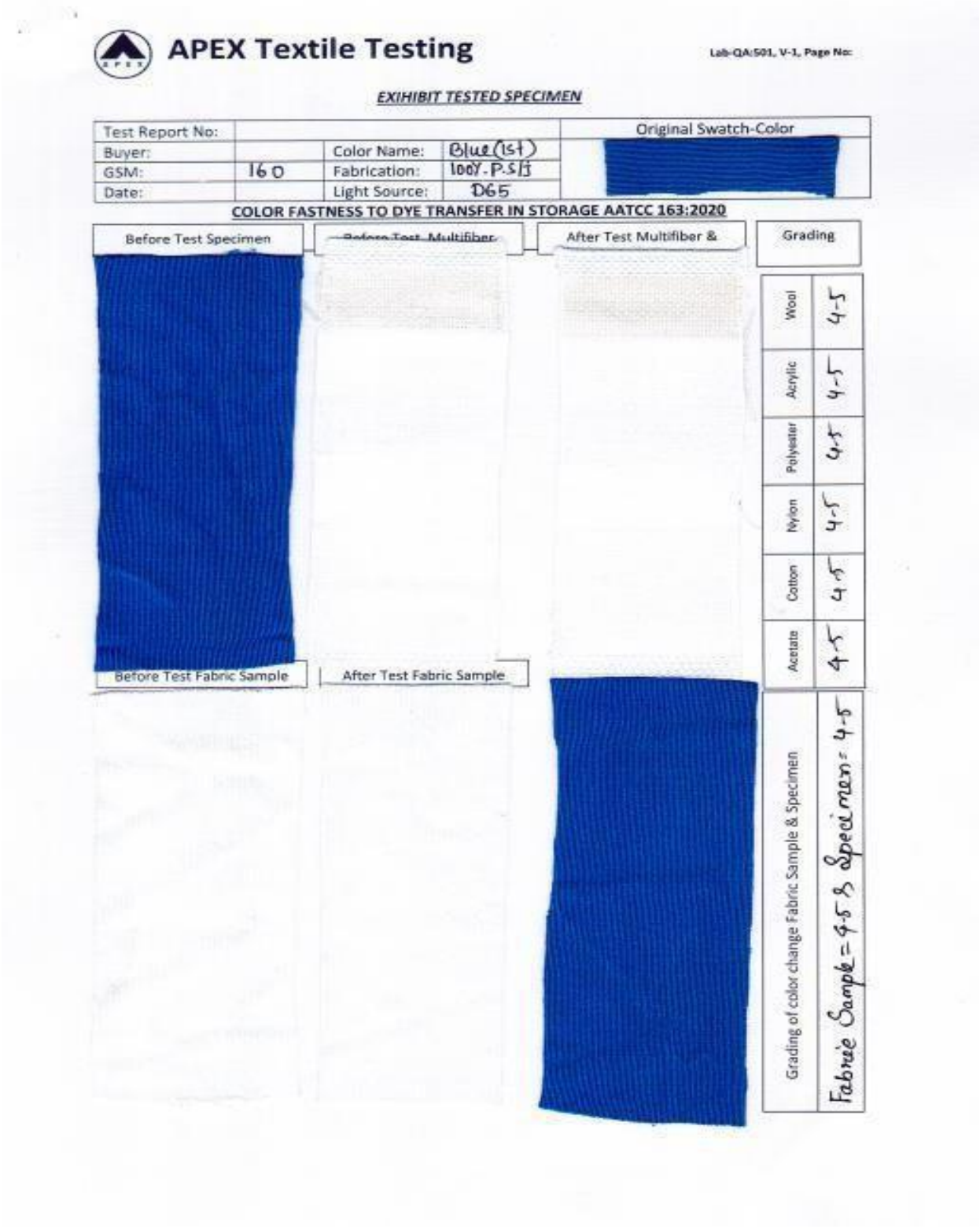
⇩

For seventy-two hours, leave the perspirometer upright in an oven set to

sixty degrees Celsius.

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

3.8.3 Polyester (1st Time) Color Fastness to Dye Transfer in Storage Test report



APEX Textile Testing

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

EXHIBIT TESTED SPECIMEN

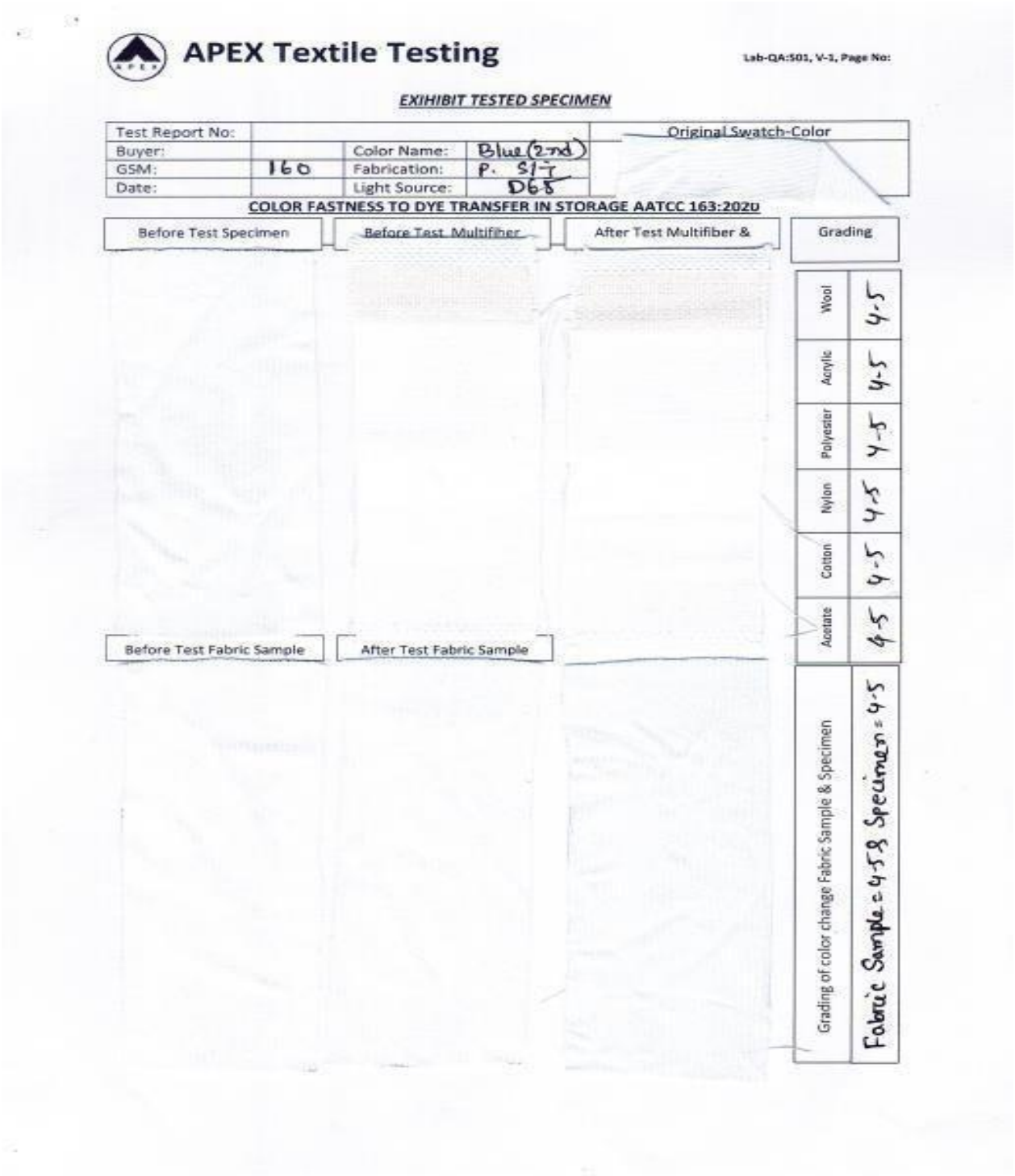
Test Report No:			Original Swatch-Color
Buyer:		Color Name:	Blue (1st)
GSM:	160	Fabrication:	100Y. P.S/J
Date:		Light Source:	D65

COLOR FASTNESS TO DYE TRANSFER IN STORAGE AATCC 163:2020

Before Test Specimen	~~Before Test Multifiber~~	After Test Multifiber &	Grading	
			Wool	4-5
			Acrylic	4-5
			Polyester	4-5
			Nylon	4-5
			Cotton	4-5
			Acetate	4-5

Before Test Fabric Sample	After Test Fabric Sample	Grading of color change Fabric Sample & Specimen
		Fabric Sample = 4-5 & Specimen = 4-5

3.8.4 Polyester (2nd Time) Color Fastness to Dye Transfer in Storage Test report



APEX Textile Testing

Lab-QA:501, V-3, Page No:

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (2nd)	
GSM:	160	Fabrication:	P. SJ	
Date:		Light Source:	D65	

COLOR FASTNESS TO DYE TRANSFER IN STORAGE AATCC 163:2020

Before Test Specimen	Before Test Multifiber	After Test Multifiber &	Grading

Wool	4-5
Acrylic	4-5
Polyester	4-5
Nylon	4-5
Cotton	4-5
Acetate	4-5

Before Test Fabric Sample	After Test Fabric Sample

Grading of color change Fabric Sample & Specimen	Fabric Sample = 4-5 & Specimen = 4-5

3.9 Color Fastness to Phenolic Yellowing (ISO 105 X-12)

3.9.1 SCOPE:

to evaluate the possibility that sterically inhibited phenol contamination will cause white and light-colored textiles to become yellow. Fabric that hasn't yellowed should be used for this test.

3.9.2 Equipment

- Seven acrylic-resin or glass plates for a perspiration tester
- furnace or incubator to keep the temperature at (50±3)°C
- Exam papers 75 x 100 mm (for a definition, see ISO 105-X18)
- 30 x 100 mm control fabric (described in ISO 105-X18)
- Polyethylene film free of butyl hydroxytoluene (BHT) A light box with a D65 light source
- A greyscale (ISO 105-A02) to measure colour change

3.9.3 Working Procedure:

- Cut two single layers of the fabric to be tested, each measuring 3 cm by 10 cm, using a ruler and scissors without marking the fabric.
- For every sample, take one test paper. Place the sample inside, creating a sandwich, after folding it in half along the 10 cm axis.
- Apply the same technique to the control cloth.
- Sandwiches should be separated by placing them between two glass dishes.
- Top each glass dish with the others. Five samples and one control cloth (a total of seven glass plates) can fit in a single perspirometer. Seven plates should remain in the stack even if fewer than five samples are analysed.
- To construct an airtight box, securely wrap the stack in three layers of BHT-free polyethylene film and seal with adhesive tape.
- Put the package inside the perspirometer, add 12.5 kPa (5 kg) of pressure, lock it, and then take the weight out.
- The test device should be placed upright on its side in the oven at (50±3)°C for 16 hours.
- Before opening the packaging, take it out and let it cool.

3.9.4 Polyester (^{2nd} Time) Color Fastness to phenolic yellowing Test report

APEX Textile Testing

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

EXIHIBIT TESTED SPECIMEN

Test Report No:				Original Swatch-Color
Buyer:		Color Name:	Blue (2nd)	
GSM:	160	Fabrication:	P. SJ	
Date:		Light Source:	D65	

COLOR FASTNESS TO PHENOLIC YELLOWING ISO 105-X18:2014

Before Test Sample	Before Test Control Fabric	After Test Control Fabric & Sample	Grading
			Grading of color change: 3
			Grading of color change: 4-5

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 ±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 ±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 ±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 with limited extensibility

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 ± 5 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. The test specimen should be compressed until the cloth ruptures.

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.

Mechanicalshaker: 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 ± 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

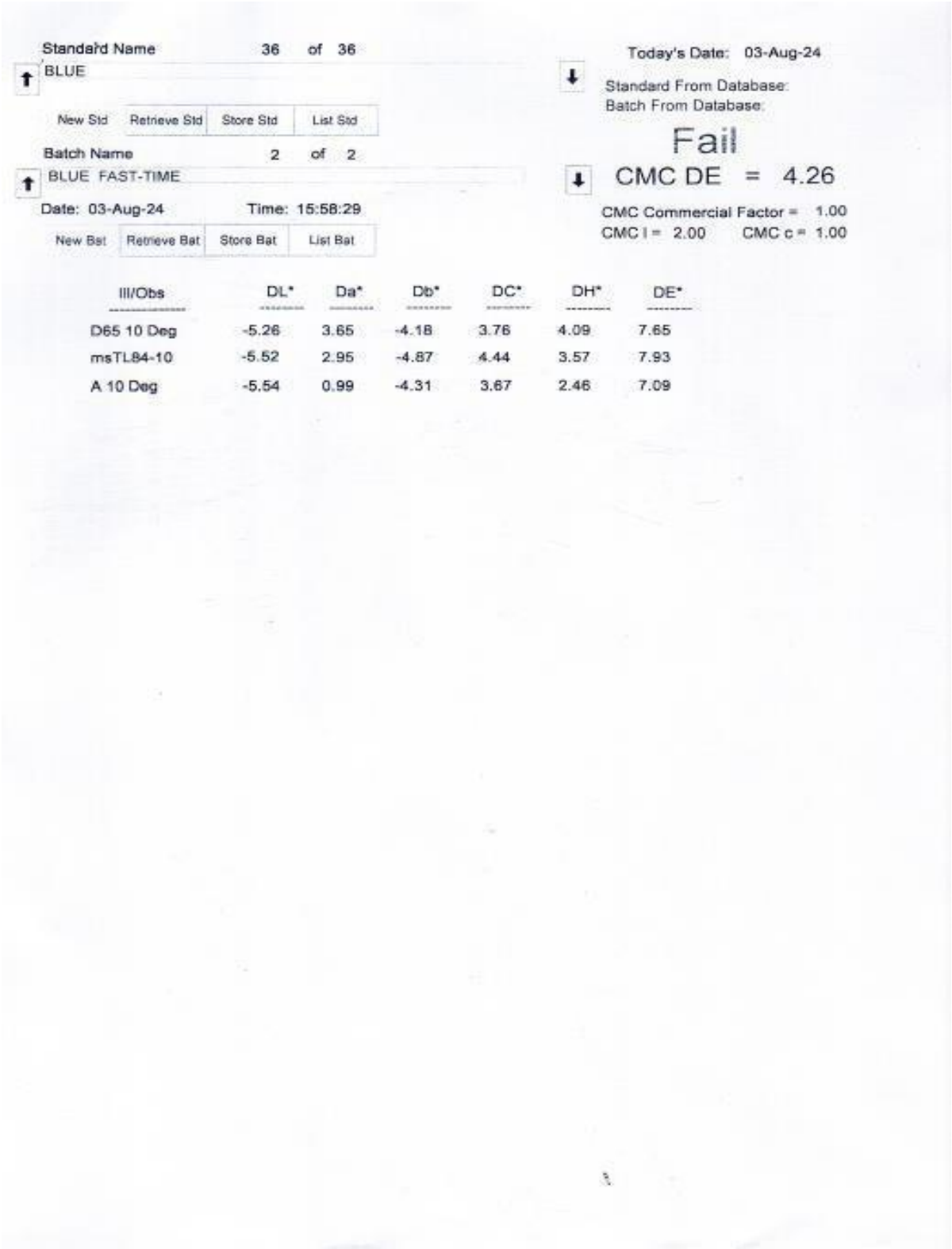
- Take note of the extracting solution's temperature. Set up the pH meter and use two buffer solutions to verify that it is calibrated.
- Until the desired pH value stabilises, submerge the electrode many times in the KCl solution used to prepare the extract.
- Before recording the pH value of this solution, 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 Polyester Dyeing CMC Report (Blue – 1ST Time)



Standard Name 36 of 36

BLUE

New Std | Retrieve Std | Store Std | List Std

Batch Name 2 of 2

BLUE FAST-TIME

Date: 03-Aug-24 Time: 15:58:29

New Bat | Retrieve Bat | Store Bat | List Bat

Today's Date: 03-Aug-24

Standard From Database:

Batch From Database:

Fail

CMC DE = 4.26

CMC Commercial Factor = 1.00

CMC l = 2.00 CMC c = 1.00

Ill/Obs	DL*	Da*	Db*	DC*	DH*	DE*
D65 10 Deg	-5.26	3.65	-4.18	3.76	4.09	7.65
msTL84-10	-5.52	2.95	-4.87	4.44	3.57	7.93
A 10 Deg	-5.54	0.99	-4.31	3.67	2.46	7.09

4.1 Polyester Dyeing CMC Report (Blue – 2nd Time)

Standard Name 36 of 36

BLUE

New Std | Retrieve Std | Store Std | List Std

Batch Name 3 of 3

BLUE SECOND-TIME

Date: 03-Aug-24 Time: 16:01:32

New Bat | Retrieve Bat | Store Bat | List Bat

Today's Date: 03-Aug-24

Standard From Database:

Batch From Database:

Fail

CMC DE = 28.33

CMC Commercial Factor = 1.00

CMC l = 2.00 CMC c = 1.00

Ill/Obs	DL*	Da*	Db*	DC*	DH*	DE*
D65 10 Deg	43.80	3.86	35.82	-31.51	-17.46	56.71
msTL84-10	46.93	5.50	41.69	-37.50	-19.02	63.01
A 10 Deg	47.82	15.44	41.38	-41.23	-15.83	65.09

4.2 Difference of Color Fastness to Rubbing Test Results

Dyeing	Polyester (1st time)	Polyester (2nd Time)
Dry Rubbing (Face Side)	4-5	4-5
Wet Rubbing (Face Side)	4-5	4-5
Dry Rubbing (Back Side)	4-5	4-5
Wet Rubbing (Back Side)	4-5	4-5

4.3 Difference of Color Fastness to Wash Test Results

Dyeing	Polyester (1st time)	Polyester (2nd time)
Color change of Specimen		
Result	4-5	4-5
Color staining of Multifiber		
Acetate	4-5	4-5
Cotton	4-5	4-5
Nylon	4-5	4-5
Polyester	4-5	4-5
Acrylic	4-5	4-5
Wool	4-5	4-5

4.4 Difference of Color Fastness to Water Test Results

Dyeing	Polyester (1st time)	Polyester (2nd time)
Color change of Specimen		
Result	4-5	4-5
Color staining of Multifiber		
Acetate	4-5	4-5
Cotton	4-5	4-5
Nylon	4-5	4-5
Polyester	4-5	4-5
Acrylic	4-5	4-5
Wool	4-5	4-5

4.5 Difference of Color Fastness to Acid Test Results

Dyeing	Polyester (1st time)	Polyester (2nd time)
Color change of Specimen		
Result	4-5	4-5
Color staining of Multifiber		
Acetate	4-5	4-5
Cotton	4-5	4-5
Nylon	4-5	4-5
Polyester	4-5	4-5
Acrylic	4-5	4-5
Wool	4-5	4-5

4.6 Difference of Color Fastness to Alkaline Test Results

Dyeing	Polyester (1st time)	Polyester (2nd time)
Color change of Specimen		
Result	4-5	4-5
Color staining of Multifiber		
Acetate	4-5	4-5
Cotton	4-5	4-5
Nylon	4-5	4-5
Polyester	4-5	4-5
Acrylic	4-5	4-5
Wool	4-5	4-5

4.7 Difference of Color Fastness to Household Laundering Test Results

Dyeing	Polyester (1st time)	Polyester (2nd time)
Color change of Specimen		
Result	4-5	4-5
Color staining of Multifiber		
Acetate	4-5	4-5
Cotton	4-5	4-5
Nylon	4-5	4-5
Polyester	4-5	4-5
Acrylic	4-5	4-5
Wool	4-5	4-5

4.8 Difference Of Color Fastness to Saliva Test Results

Dyeing	Polyester (1st time)	Polyester (2nd time)
Color change of Specimen		
Result	4-5	4-5
Color staining of Multifiber		
Acetate	4-5	4-5
Cotton	4-5	4-5
Nylon	4-5	4-5
Polyester	4-5	4-5
Acrylic	4-5	4-5
Wool	4-5	4-5

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

Dyeing	Polyester (1st time)	Polyester (2nd time)
Color change of Specimen		
Result	4-5	4-5
Color staining of Sample Fabric		
Result	4-5	4-5
Color staining of Multifiber		
Acetate	4-5	4-5
Cotton	4-5	4-5
Nylon	4-5	4-5
Polyester	4-5	4-5
Acrylic	4-5	4-5
Wool	4-5	4-5

5.0 Difference of Color Fastness to Phenolic Yellowing Test Results

Dyeing	Polyester (2nd time)
Color change of Control Fabric	
Result	3
Color staining of Specimen	
Result	4-5

4.2.3 Bursting Strength Test Results (Polyester 1st Time Dyeing)

James Heal - TruBurst Results

ISO 13938-2 2019

Bursting Properties of Fabrics-Part 2

Temperature: 20 'C
Relative Humidity: 65%
Weight: 0
NTests: 3 / 3
Diaphragm: 1.0mm
Test Area: 50cm2 (79.8mm Dia)
Inflation Rate: 11kPa/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	199.5	24.8	20.8
2	207.8	26.0	21.5
3	206.1	22.6	21.4
Mean	204.5	24.4	21.2
Q95	10.9	4.2	1.0
Q95 Max	215.4	28.7	22.2
Q95 Min	193.6	20.2	20.2
CV%	2.1	7.0	1.8

Diaphragm Correction: 25.6kPa
Instrument Model: 1440
Instrument Serial: 1440/20/1234
Software Version: 2.0.3.0
Hardware Version: V1.21

4.2.3 Bursting Strength Test Results (Polyester 2nd Time Dyeing)

James Heal - TruBurst Results

ISO 13938-2 2019

Bursting Properties of Fabrics-Part 2

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

5.1 pH-value of (Polyester 1st Time Dyeing)

Slop %	Value	Diffrence	Result
95%	6.57	0.02	6.56
95%	6.55	0.02	

5.2 pH-value of (Polyester 2nd Time Dyeing)

Slop %	Value	Diffrence	Result
96%	6.54	0.01	6.55
96%	6.56	0.01	

CHAPTER-5
CONCLUSION

5.1 CONCLUSION:

After the second dyeing, the polyester's leftover dye produces a much better outcome and lightens in colour. The second time coloured test result is good because polyester fabric has minimal dye absorption because the dye content was decreased during the second dyeing process. However, because polyester fabric absorbs more colour because it contains more dye when dyed for the first time, the pH value and bursting strength test results are poor.

Reference:

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