Faculty of Engineering

Department of Textile Engineering's

Study On

"Evaluation of Sustainable Dyeing Practices for Cotton, and Viscose Fabrics Using Bi- Functional Reactive Dyes"

REPORT ON

Course Title: Project (Thesis)

Course code: 0723-600 TH-600

Submitted By

Mahedi Hasan

ID: 0242310014123004

Supervised By

Md. Mashud Raihan

Assistant Professor

Department of Textile Engineering's

Daffodil International University

The Report presented in Partial Fulfillment of the requirements for the degree of Master of Science in Textile Engineering

DECEMBER 2024

Letter of Approval

30-12-2024

The Head,

Department of Textile Engineering's

Daffodil International University

Daffodil Smart City (DSC), Ashulia.Dhaka-1341

Subject: Approval of Project Report of M.Sc. In Textile Engineering

Dear Sir,

I am proud to inform that the project report of the student having the **ID 0242310014123004** in the project topic **"Evaluation of Sustainable Dyeing Practices for Cotton, and Viscose Fabrics Using Bi- Functional Reactive Dyes"** has been thus completed and is now ready for examination. This report has been prepared carefully and accurately based on the study carried out in "**Knit Concern Group**". It also has critical assessment by reviewing observational data and including supporting materials. The student was therefore engaged in all the project activities closely to have better grasp of the projects.

Hence, I humbly appeal to any dedicated reader to pay attention to this project report and possibly use it for one final assessment. Your compliance with the above in this regard will be much appreciated.

Your Sincerely

…….

Md. Mashud Raihan

Assistant Professor

Department of Textile Engineering's

Daffodil International University

DEDICATED TO MY PARENTS

ACKNOWLEDGEMENT

Firstly, I would like to extend my deep-soul thanks to my supervisor **Md. Mashud Raihan,** Assistant Professor, Department of Textile Engineering, Daffodil International University, for his constant contribution and support to this research work. There is a lot to learn from him and to learn with him because he has inspiring ideas and a fantastic work attitude. Both the ideas offered and the support provided have been very much helpful in finishing this work successfully.

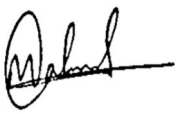
I am very grateful to **Engr. Md. Tanvir Ahmed Chowdhury**, Assistant Professor & Head, Department of Textile Engineering, for his kind cooperation and help. I will also appreciate those who helped me throughout my study at the Textile Engineering Department at Daffodil International University. I owe my development in both participation and argumentation during our coursework. I would also like to acknowledge the help of the staff of "**Knit Concern Group**" who provided help and support in the planning and formulation of this research.

I also acknowledge the loving support of my parents and family members. Last but not the least, thanks go to all the people who have assisted, helped and inspired me to complete this task at various stages.

SUPERVISORE DECLARATION

I hereby declare that, this report has been done under the supervision of **Md. Mashud Raihan**, Assistant Professor, Department of Textile, and Daffodil International University. I also declare that neither this internship report nor any part of this internship report has been submitted elsewhere for award of any degree.

Submitted By:



Mahedi Hasan

ID Number: 0242310014123004

Department of Textile Engineering

Daffodil International University

ABSTRACT

The growing popularity of environmentally-friendly textile manufacturing has started the study of green dyeing methods. Here, emphasis is laid on the issue of the dyeing method on the use of bi-functional reactive dyes on cotton and viscose fabric in terms of water and energy use, and exposure to environment. Effluent, water and chemical usage and fabric performance may be improved through bi-functional reactive dyes, containing both reactive and bifunctional groups. The dyes being studied are cotton and viscose that has been massively applied in the textile industry. Such fabrics have been tested in terms of how they receive color, how these colors are retained by the fabrics, and their environmental friendliness with regard to these new dyes. The comparisons with the traditional dyeing practices are made in order to identify the extent of effluency, discharge into various toxic chemicals, and recyclability in the course of the dyeing procedure. It has been established that bi-functional reactive dyes have the ability of replacing other types of dyeing processes with a lower environmental load without compromising the overall quality of a product or without any side gains in its quality. The boundary of future explorations is a sustainable dyeing methodology technology and its application in the industry, to attain sustainable growth in the textile industry. Through this work, it is imperative to say that bi-functional reactive dyes are necessitated since they are potential technological change of reaction of eco-friendly dyeing that may meet the aspect of global dyeing without compromising its quality. However, further research is needed to make such methods more industrialized and more presentable.

CONTENTS

List of figures

List of Tables

Chapter-One

1.Introduction

1.1 Background of the Study:

Green dyeing: to the textile industry Textile industry seeks more and more sustainable dyeing. These dyes have come into interest due to their environmental compatibility and that they may generate strong, fast colours. And the traditional dyeing processes can even be very much water-intensive, which is a disturbing requirement in places where water is scarce. Cotton and viscose are usually some of the common textiles employed in our fashion and clothing industry. Whilst cotton is viewed as a natural fiber, rayon (also known as viscose) is a semi-synthetic man-made fiber that has been derived using cellulose. When it comes to respect to the colour fastness and the performance of the fabrics, the dyeing process is required in both. Normally however, traditional dyeing of such fabrics need the use of harmful chemicals, vast quantities of water and energy. There is the possibility of such dyes providing solution to the conventional dyeing problems. The process is energy-efficient, and water saving, since it allows laundering of materials at lower temperatures and shorter time. To that, increased colorfastness will reduce our requirement of rough chemicals and prevent polluting wastes. Nevertheless, the increasing concern with the issue of sustainability is prompting an increase in the demand of bi-functional reactive dyes. Consequently, the industry might apply environmental friendly means and enhance its manufacturing process.

1.2 Objectives of the Study:

- Test level of strength of the colors, color fastness to washing, light and rubbing and also the amount of dye taken up on cotton and viscose fabrics using bi-functional reactive dyes.
- Check the sustainability level of bi-functional reactive dyes regarding the environment and conventional dyeing processes. Some of them include the evaluation of the consumption of water, electricity, chemical waste and toxic dyes.
- Still consider possibilities of minimizing the water and energy consumption during the process of dyeing by determining the optimal parameter values like temperature, time, the pH value and dye assistants when bi-functional and reactive dyes are applied.
- Determine the way that bi-functional reactive dyes are capable of reducing wastage of dyes and recovering excess dyes by mainly focusing on waste water treatment and dye waste recovery.
- Publish regulations or recommendations on application of sustainable dyeing practice and specific application of bi-functional reactive dyes with both cotton and viscose fabrics as a mere example.

1.3 Methodology

- Textile Industries.
- Book.
- Internet.
- Industrial incomplete report.

Chapter- Two

2. Literature Review

2.1 Viscose:

The viscose or the rayon is one of the semi-artificial variety that is spun by regenerated cellulose. Whitening wood pulp or cotton using a chemical results in the formation of viscose liquid, and this is turned into very thin fibers. Fabric is made after binding fibers that could be done using the hands or machines. Owing to the fact that viscose is soft, allows free flow of air through it and is easy to connect, it is used in clothing as well as in the furnishing of our homes. Velvet does have many uses and people buy it out of the fact that it can be touched similarly to silk or cotton in similar aspects, and it is cheaper. Unless we handle the chemicals used by manufacturers in the right manner it may be disastrous to nature, yet environmentally friendly methods of producing viscose are assisting. Green Chemistry leads to the minimization of number of chemicals and improved recycling of water and solvents upon the production of products.

Viscose fabric

2.1.1 Viscose Fiber Manufacturing Process:

Viscose fiber is created by turning raw cellulose which can be found in wood pulp or cotton linters, into something that can be turned into fabric. I will explain in detail the vital processes used when producing viscose fibers.

1. The System for Getting Cellulose Ready

Mostly, wood pulp, bamboo or cotton linters are used by cellulose producers.

The raw material is cut into pieces to support better use of the chemicals.

Taking out dust and such, by either soaking or blowing the cellulose.

2. Find out what you can do to make your body more alkaline.

Primary cellulose is reacted with only sodium hydroxide solution. Researchers break down the cellulose structure so the reactions take place easily and smoothly. It's better to let your leaf sit overnight before picking it.

3. Does Decay Also

When Fun Sized Stepping is done, the pulp is then shredded into small pieces.

For a few days, the cellulose is held aside as the viscose solution is prepared. As Zwijacz reports, the process of polymerization allows the age of fibers to be managed and their usefulness can be adjusted, says Rucci.4. Xanthation

Cellulose crumbs dissolved in carbon disulfide produces the chemical called cellulose xanthate. By treating and heating cellulose in carbon disulfide, viscose is formed and it is both yellow and sticky.

Cellulose xanthate results from the reaction of age cellulose with carbon disulfide and sodium hydroxide.

5. Dissolving

Adding just a small amount of sodium hydroxide to cellulose xanthate makes liquid viscose.

Put all the ingredients into the bowl and allow them to stay touching for a bit to help them bind.

6. Spinning

During that step, viscose goes through spinnerets and is poured into the desired acid for treatment.

After dipping the viscose solution, filaments are formed. The wet spinning method is given the name chemical fiber during production.

The delicate and smooth fibers of cellulose xanthate are made during the coagulation bath.

7. I start by washing and afterward put something on the fabric to help neutralize it.

After the hanks are done, all sulfuric acid, sodium hydroxide and carbon disulfide that remains on the fibers is cleaned off in the next process.

The unused chemicals are neutralized on the side to protect the features of the fiber.

8. Working on stretching and lifting increases your movement and makes you better at coordination.

Once stretched, the cellulose fibers move aside and grow sideways in the fabric. Heat-treated protein makes it possible to shape the fibers into yarn for cloth making.

9. Drying

After fiber has dried, the moisture is extracted so they can continue with the next process.

10. Cutting or Spinning into Yarns

Depending on its purpose, drying fiber can then be split into short staple fibers or woven into continuous filament yarns. The yarns can shape into a basic weaving or knitting form or continue to be spun into soft chiffon or satin.

11. Finishing

Many finishing procedures are used on viscose fibers to make them more attractive, comfortable and excellent performers. Examples of treating these are dying, bleaching, softening and coating fabrics with chemicals to improve their ability to resist water or flames.

Environmental Considerations:

Viscose fiber is produced with chemicals such as carbon sulfide and sodium hydroxide and these can cause environmental problems if handled improperly. At the same time, it is becoming more important to make the process sustainable by better recovering chemicals, producing less garbage and using less harmful substances.

2.1.2 Physical Properties of viscose Rayon:

The fact that viscose fiber is otherwise known as rayon is made through the use of remade cellulose is no secret. These are the notable physical characteristics of viscose fibers:

1. Appearance:

Viscose fiber is supposed to be smooth, shiny and may appear exactly like silk.

Safety pins are also available in both filament and staples forms.

2. Strength:

As compared to polyester or nylon, the viscose fibers are not that strong.

Being wet makes them retain about 70 percent of their dry strength so they are not this capable of resisting moisture.

3. Elasticity:

Viscose is not considerably elastic. At times cotton rips or misshapes more readily than nylon or polyester.

in this regard therefore, there is little recovery once stretched hence the region can result to bagginess as time progresses.

4. Absorbency:

Viscose fiber is absorbent due to water and sweat. Hence, one can wear it easily during periods when one feels hot and humid.

It is usually incorporated in the blend to produce towel and other absorbent cloth materials.

5. Thermal Conductivity:

Viscose materials pull heat out and they enable people to remain cool during warm times.

Due to this, the suit will enable the user to breathe properly and be relaxed.

6. Moisture Regain:

Viscose moisture regain rate is considerably high which absorbs about 11-13 per cent of its weight as moisture, thus it is quite comfortable in hot climate.

7. Drape:

Soft and flowing garments and fabrics are better made out of the viscose since it floats very well.

8. Resilience:

Viscose is not resilient i.e it wrinkles so easily and when they crease they just stay that way.

9. Density:

Mainly, the average density of viscose is 1.5 to 1.6 g/cm3 and this implies that they are less dense than most natural fibers such as cotton.

10. Thermal Stability:

Heat easily alters the structure of Viscose fiber that might make them disintegrate when exposed to it. When you iron or apply anything on your clothes that heats, be very cautious.

11. Biodegradability:

The fact that viscose is a product of cellulose may be used on its advantage, since it is easy to decompose in the earth as compared to the totally artificial fiber.

To sum up, viscose fabric is comfortable, but its strength, resilience and durability lower when things get damp.

2.1.3 Chemical of Viscose Fiber:

Important chemical properties of viscose fiber enable it to react differently under different usages. The following chemical aspects are considered to be the most significant in viscose fibers:

1. Cellulose-Based:

The primary substance used as viscose is cellulose that is located in the walls of plant cells (normally wood or cotton pulp). Cellulose is brought in the form of a thread by means of chemical processes.

Viscose is made of cellulose as the raw material, but, is somehow chemically processed (e.g. kneaded in solutions with sodium hydroxide and carbon sulfide) to convert it.

2. Chemical Reactivity:

Alkaline: The viscose fibers are not tolerant to alkaline solvents. Cellulose becomes exposed to sodium hydroxide in the process of making viscose; consequently it is easily broken down in presence of strong bases.

Acid Sensitivity: Viscose is sensitive to harsh acid which would break apart its structure and render it less strong.

3. Moisture Absorption:

The viscose fibers readily take moisture that is found in the atmosphere very rapidly. The fiber is comfortable on the skin as it can absorb 1113 percent of its weight in moisture but then this makes fiber weak when it is wet.

4. Flammability:

Cellulose forms the major part of viscose fiber, thus they would go up in flames in case there is a source of fire. The rise in temperature has ensured that the fibers are highly flammable and, therefore, can easily be burned and raise the chances of a fire in some areas.

5. Degradability:

Viscose is produced under cellulose hence making it biodegradable. With time in the natural environment, the viscose fiber may tend to decompose as a result of moisture, oxygen and the presence of microorganisms.

As a result of this property viscose is more friendlier to the environment than fully synthetic polyester but its degradable nature is by limited when mixed with other fibers or even when subjected to effects by chemicals.

6. Dye Affinity:

The viscose fiber is very receptive to stains and, therefore, acquires it well to provide level and bright results. Due to having hydroxide groups, cellulose can easily bind dye molecules.

One can dye fiber with reactive dyes, acid dyes and vat dyes among others.

7. Chemical Stability:

Viability performance Normal conditions do not cause interaction of viscose fiber with mainstream chemicals. When you expose the fiber to powerful acids or alkali it will lose its strength and integrity.

8. Antimicrobial:

Although in itself viscose undergoes biodegradation, it is not naturally a resistant microbial material (such as mold and mildew), particularly when exposed to damp or wet environments. This may cause formation of degradation of fibers when it is exposed to moisture over a long time.

9. Solubility:

In the production of viscose, some solvents, especially a strong alkali (like sodium hydroxide) and carbon sulfide are used to dissolve viscose. When the fiber has been created and dried it can not dissolve in the most common color solvents.

10. Environmental Impact:

Although viscose fibers can be biodegraded, production of these using toxic chemicals like carbon sulfide, sodium hydroxide and sulfur compounds, entails a lot of environmental problems.

There is an on going attempt to develop more environmentally acceptable viscose production such as chemical reuse systems and low pollution systems.

All in all, viscose fiber inherits the trait of cellulose that is acid and alkali sensitive, highly absorbent and finally biodegradable. Rayon can be used effectively in making clothes and fabrics and it can also be dyed owing to its chemical characteristics but it is highly delicate and thus is easily destroyed.

2.1.4 The process of high tenacity viscose fiber:

With the purpose of giving hi ten viscose rayon creat more strength and durability; several complex procedures are in use. This kind of fiber which gets various treatments and additives has wide applications in the textiles.

Preparation Steps:

Raw Material Treatment: Waste cotton clothes undergo scrubbing, cutting and wash in a liquid consisting of sterilizing agent in a process that takes between 1 to 1.5 hours (Hookup,2020).

Reinforcement addition: A primary reinforcing agent is added to the stock solution of the viscose glue and a defaming followed by a filtration is carried out (Wen bin ET Al., 2017).

Spinning process: this now-treated solution combines with a spinneret (or simply a hole) and is now placed into a coagulation bath which consists of a second reinforcing agent and then the viscose thread is formed (Wen bin ET Al., 2017).

Post-Processing: The fibers are taken through drafting and are inputted to a third reinforcement agent in a spinning bath, thus becomes strengthened (Wen bin ET Al., 2017).

Performance Characteristics:

Strength Metrics: The dry breaking strength of high-tenacity viscose fibers is greater than 3.10 Nc/ detox and that of wet breaking strength is 1.60 NC/tax (Tao ET Al. 2015) (Tao ET Al., 2015).

Elongation properties: The elongation capacity of the fibers is not very significant with a dry elongation at break range of 15-19 (Tao ET Al. 2015).

The fact that high tenacity viscose rayon is extremely strong and extremely amenable to utilization material, obligates people look at the ecologic effect of its formation. The question of the sustainability is increasing in the sector of the production of fibers within the textile industry.

2.1.5 Use of viscose fiber:

Wood pulp or cotton liners are used to create the versatile material called viscose fiber which is a type of rayon. The softness, breath ability and flexibility of cotton make it useful in many industries. There are some main uses for viscose fiber which include:

1. **Textile and Fashion Industry**:

   Dresses, shirts, blouses, skirts, and suit: Dresses, shirts, blouses, skirt and suits are usually made using viscose since it possesses good feel and shape. Much of the time it is then combined with cotton, wool or polyester.

   Lingerie: Lingerie laments to be soft and stick to the skin hence viscose is applicable in this attire.

   Active wear: Active wear fabrication needs to be warm as well as breathable and includes the use of a blend of viscose.

   Home Furnishings:

   Upholstery Fabrics: Furniture Covers: Covers of furniture are usually made out of viscose due to its luxurious feel and also the beauty it poses.

   Curtains and Drapes: It is used to make curtains because when it hangs it dips well, therefore, it is soft looking.

   Bedding: Occasionally bedding fabrics comprising of sheet materials, pillowcases and blankets are added with viscose to make them silky and soft to touch.

2. **Industrial Applications**:

   Nonwoven Fabrics: Viscose is used to make many of the non woven products including diapers, medical wipes and certain hygiene products.

   Filters: Viscose is absorbent, and therefore it can be used in air and liquid filters.

   Paper Products:

   Tissue Paper: Tissue papers (usually facial tissues and napkins) are produced using viscose since they are soft as well as absorbent.

   Speciality Paper: Special papers can also be made by the process like premium writing paper including banknotes.

3. **Personal Care products:**

   Cosmetic Wipes: Viscose is applied in cosmetic wipe and facial tissue due to the fact that it is soft on the skin and has high absorption capacity.

4. **Medical Products:**

   Surgical Dressings: Viscose could be employed in the making of medical bandage and dressing since it is absorbent and soft.

5. **Sustainable Use/Environmental Use:**

   Biodegradable: Viscose material is biodegradable because it is a type of cellulose hence more sustainable than polyester which can hardly be broken down. Greater focus is being put on it in environmentally-friendly textile production. Due to its softness, absorption and

flexibility, viscose is frequently used in many applications that fit into their requirements as well as tablet against the demands**.**

2.1.6 Process of Viscose dyeing:

It requires the right dyeing method to make viscose fiber durable as well as to impart lasting brightness into it. Due to the fact that viscose is a type of cellulose (a plant fiber) it also acts like natural fibers such as cotton in the manner it accepts color during the dyeing process. Much the same process as that of carrying out a dyeing operation with cotton or on other cellulose fibres, is followed with regard to viscose. Below is in conclusion a brief description of the dyeing of viscose:

1. Pre -Treatment (Scouring and Bleaching)

Scouring: In order to eliminate intrinsic lodged a wax, oil or dirt in the viscose fabric, the first objective is to clear them off. This includes wetting the garment in cleaner usually sodium hydroxide in order to wash away the filth and dirt on the cloth.

Bleaching: Viscose cloth can be bleached in case they are not already white or have to be made lighter. In this case bleach (such as hydrogen peroxide or chlorine) is applied to assist in absorbing the dye by the fiber.

2. Dyeing:

Viscose fiber is dyed using various dye, however the most popular dyes are:

Reactive Dyes: Since the reactive dyes create a covalent bond with the fibers, this can make the viscose fibers retain their color in face of washing extremely well. Reactive dyes on viscose tend to give bright colours and colour fastness of those colours as well.

Direct Dyes: You can dye fabric in them and you do not need a mordant. Direct dyes are acceptable on viscose, but their colors can fade or run, in comparison with reactive dyes colors.

Acid Dyes- in the course of dyeing viscose, these acid dyes can be used sometimes, and they attach themselves to the protein bearing areas of wool or silk. During processing of viscose blend they can add certain effects in dyeing.

1. **The steps that normally take place during the dyeing process include the following:**

Preparation of Dyebath: Clean water is put and some salt or any other acid added to the water and upon mixing, some particular dye added.

Fabric Immersion The treat viscose fabric is immersed in dye bath. It is rubbed whereby the dye is evenly distributed on its surface.

Heating: Some kinds of dye need to have heat during the dyeing process in the dye bath so that they would adhere well to the fiber being dyed. Choosing the type of dye and the shade is conditional by the available heat and time.

Fixation: The fabric may be made to still look wanting of more color; a fixation agent may then be applied on it. The dyes remain for more time and are easier to wash.

3. Once Dyeing has been done: (Washing and Hanging):

Washing: Dye that gets embedded on the mountain climbing gear is removed by washing the dyed equipment. It keeps the colours of the clothes un-faded in washing.

Softeners: It is also introduced as softening agent in viscose.

Drying: It can be air dried or you can use tumble dryer depending on its thickness and how you like it to be**.**

4. Finishing:

Finishing: Dyers make further operations upon the cloth by calendaring it (to smooth it), or mercerizing it, (to set it sheeny and tough). The final procedure enhances the looks and utility of the fabric.

Color Control: Another concern - during the quality control the color finishing will be an issue where it needs to be right at the end since mistakes can occur during the process of dyeing.

5. Post-Dyeing Care:

Curing: Some dyed fabrics could require steam or heat settings in order to have the dye permanently set or remain.

Quality Tests: There should be tests on color fastness, light fastness and wash tolerance before one can use the fabric.

6. Important point in dyeing Viscose:

Absorbency of Water: Viscose is very absorbent in nature and is able to take in dye rapidly though it must be handled carefully to prevent mismatched color formation.

Shrinkage: Since viscose is prone to shrinking in case it comes into contact with some water you will be required to use caution when washing and drying the material so that it does not shrink in size.

Color Bleeding: Some of the dyes may bleed on other garments during the initial wash and that is why you need to be careful handling them.

Viscose is only correctly dyed by following a strict process consisting of pre-treatment, dyeing, post-treatment and finishing. The choice of dye will change how the fabric looks, feels and how strong it is. Many people prefer reactive dyes because of their strong colorfastness and vivid tones which makes them suited for viscose textiles.

2.1.7 Viscose Free Exhaust Dyeing fiber

An assortment of superior procedures is adopted to exhaust dyeing of viscose loose fiber to enhance the dye consumption rate and efficiency. One of its outstanding strengths is the deep coloration,

good uniformity, and less environmental concern. In the subsequent sections, the key aspects of the process will be outlined.

Continuous Dyeing Process:

- This dyeing system for viscose loose fibers saves time and reduces what is used for dyeing compared to older dyeing processes (Wei dong ET Al., 2015).
- These steps are dye liquor spraying, padding and hot air drying and they improve how fast dyeing is done and cut down on costs (Wei dong ET Al., 2015).

Exhaust Dyeing Method:

- This method adds sulfur dyes to the fiber in a low oxygen setting which encourages the dye to penetrate deeply into the fiber (Stuart, 1995).
- With this technique, colors and details are fixed well which makes it valuable for use in textile making (Stuart, 1995).

Alkaline Pretreatment:

- Studies have proven that alkaline pre treatment with sodium hydroxide increases how much dye can enter and bind with viscose fibers (Chattahoochee, 2009).
- The purpose of this treatment is to improve dye absorption and also change the shape of the fiber which results in richer colors (Chattahoochee, 2009).

Although exhaust dyeing gives many good results, special attention must be given to how chemicals are handled to avoid environmental issues, proving the importance of sustainable practices in the dyeing business.

2.1.8 Viscose Fabric Dyeing Flow Chart:

Process Flow Chart of Viscose Fabric Dyeing:

Water filling in the dyeing machine

↓

Fabric loading

↓

Hot Wash, 80^{o}C, 10 min

↓

Drain

↓

Water filling

↓

Chemical Auxiliaries

↓

pH check (6.5-7.5)

↓

Reactive dye (dosing 30 min) (Run 15 min, Temp 50^{o}C)

↓

Salt dosing 2 step, 60^{o}C (Run 15+15 min)

↓

Soda 60 min dosing (Run 60 min)

↓

Shade check

↓

Cooling

↓

Drain

↓

Acetic Acid (Neutralization)

↓

Drain

↓

Soaping

↓

Drain

↓

Hot Wash (2 or 3 times)

↓

Cool wash

↓

Shade check

↓

Fabric unload

2.1.9 What is the number of kinds of viscose Fabric:

The viscose is a type of rayon fabric that consists of regenerated cellulose and is regularly derived out of wood pulp or bamboo. It is inexpensive material suitable in a lot of uses because it is as smooth as silk. Viscose has a number of forms and each form is utilised in definite characteristics and uses. Advertising is of three major types.

1. Standard Viscose (Regular Rayon)

Description: Most of the kinds of viscose constructed as garnered in bulk, are fashioned through cellulose discontent in a dissolvent and re-working it into a fibrous commodity. The touch sensation is good, hangs fairly well and makes breathing possible**.**

Applications: Is normally found in dresses, blouses, skirts and majority of the clothes of the fad.

2. High Wet Modulus Viscose (HWM)

Description: HWM viscose uses water and thus it does not shrink significantly once washed since it is water-resistant. It is designed to be more tough and durable as an old fashioned viscose.

Uses Sometimes used in longer life clothing, such as home textiles, long life pieces of clothing and active wears.

3. Flame-Retardant Viscose

Description: This kind of viscose is made by using special chemicals that give it the capability of resisting fire. It is commonly used in fire resistant clothes and equipment that have to be fire resistant legally.

Uses: clothing, uniforms or other protective material in case of possible flames or heated environment.

4. Eco Viscose (Eco friendly Rayon)

Description: A lot less water and chemicals are consumed during the eco viscose production compared to the regular viscose production. The paper could either be made of wood that is cultivated using forest resources responsibly or of recycled paper.

Uses: Eco-friendly firms in fashion produce their products using eco viscose as a greener future.

5. Bamboo Viscose

Description: Bamboo viscose will not be created with wood pulp as wood pulp is created but with bamboo pulp. Promoters usually argue that bamboo is superior, because it grows quickly, and less chemical work is required.

Applications Bedding, clothing and household textiles are examples. It comes to be noted as soft and automatically decreasing cumulative growth of the bacteria.

6. Viscose Jersey

Description: Viscose jersey is a knitted fabric of viscose not to mention it can stretch as normal viscose does and it is also soft.

Uses: Due to its elasticity and comfortability T-shirts, dresses and other informal attires are manufactured using spandex blends.

7. Linen-Look Viscose

Description: It is made to have a look and feel similar to linen. The material is airy and light and it has a ruffled, linen-like appearance.

Uses: Blouses, skirts and dresses are part of summer wardrobe.

8. Viscose Satin

Description: It is woven such that it forms a smooth and glossy surface as close to silk. Even though you still achieve a luxurious feel and appearance the fabric is not as expensive as that of silk.

Applications: Wears like evening wears, formal and little accessories like scarves and blouses.

Summary:

There are a total of the major types of viscose which are regular viscose, HWM viscose, flame-retardant viscose, eco viscose, bamboo viscose, viscose jersey, linen-look viscose, and viscose satin. The different categories differ by method of production, longevity, texture and application. The selection of a particular type to be employed is based on the demands that the fabric wants to comply with, i.e., soft or strong, look or environment.

2.1.10 The history of Viscose fiber:

The story of viscose fiber or rayon, started with early attempts to make man-made fibers and has grown to become a major choice in the textile world. Here is a well-detailed account of its historic development:

Early Developments (Late 19 th Century)

Late 1800s: The Late nineteenth century was the time when people started experimenting with trying to create a fiber with the same luxurious properties as silk. Silk was too expensive and by virtue its making was not so easy in large quantity and its price was too high, people began trying to find a cheaper substitute. Initially, people were able to develop artificial fibers by extracting cellulose in wood or plant and redeveloping it as fiber.

Hilaire Marin Reichelt (1855): A French Chemist by the name Hilaire Marin Reichelt attempted to combine cellulose (the material obtained in plants) with chemicals in an attempt to produce the material in the form of silk. Even though his solutions were not applicable in business his work was the foundation of what was to be built later.

The Viscose Process was Invented (1890s)

The method to turn cellulose into a dissolved state using sodium hydroxide (caustic soda) that brings about the formation of a viscous solution was developed by Charles Frederick Cross, Edward John Bevan and Clayton Beadle (1892). Subsequent to that, the viscose was forced to go through very small holes into a condensing tank full of chemicals that enabled the cellulose to reform and grow into fibers. This process later used to be referred to as the viscose process and this is how viscose fibres are currently manufactured. The term viscose is associated with the sticky liquid formed through chemical behavior of cellulose.

1894: Cross, Bevan and Beadle came out with the first modern rayon (viscose) with the patent of their viscose process. With the invention, it was now possible to produce artificial fibers on large scale hence making silk cheaper.

Commercialization (Early 20 th Century)

1905: British Rayon Company installed the first commercial scale factory to produce viscose. Rayon being similar to silk, and having got the same feeling, was termed as artificial silk. Dye was also added into garments, into a broad variety of industrial goods such as rotating equipment as well as engineering adhesives.

1910s: By this time viscose had already conquered the market in Europe and North America with ease. They used a lot of fabric in dressing sets such as dresses, underwear, linings, among several garments. To cover various upholstered furniture and home items, the rayon was incorporated.

The game and the expansion (1920-1930)

1920s; More people used, rayon and hence there was more output of the product in the world. Better production methods guaranteed longer life span of rayon fibers which could be used in other consumer products and industries. By this time rayon was already gained the fame of being a fussy material because it was like silk although it was easily accessible.

The 1930s: The scientists were able to harden the fiber and make it stronger by coming up with high wet modulus (HWM) rayon. This was very useful where the application needed greater strength such as the tire cords and any other material which needed some sort of surgery.

Post-War Growth (1940s-1960s)

1940s-1950s: With World War II over, the rayon industry kept growing and soon nylon and polyester became important new types of synthetic fibers. It was still important in the textile industry because of how flexible it was and since it cost less than other fibers.

1960s: There was a rise in fashion using rayon, mostly for clothes like dresses, suits and shirts. Concerns about the environment appeared because making rayon included the use of dangerous chemicals, one of which was carbon disulfide.

Technological innovation and Environmental concerns (1970sFF1980s)

1970s-1980s: As more people started to give attention to the environment, a number of them realized that the production of viscose was a harmful process due to the chemical it applied. Caused

during the manufacturing of rayon, such chemical compounds like carbon disulfide endangered both the workers and the nature. This made the businesses develop more sustainable methods of production**.**

Closed-loop systems: The viscose industry was changing because of the environmental concerns to closed-loop systems that helped in the reduction of chemicals and emission. The new process made rayon-manufacture more sustainable.

The 21 st Century: Sustainability and Innovation

2000s-Present: Today, the viscose business has to face the issues related to sustainability. As the demand of eco-friendly fibres has increased, Lyocell (Tencel) is a fibre which has just come into the market. Lyocell uses N-methyl morpholine N-oxide (NMMO) which is a greener solvent to produce wood pulp rather than the typical chemicals required in the viscose line. It is constructed via a more sustainable closed-loop concept.

Environmental Practices: Multiple manufacturers of rayon are seeking to seek ways to produce conventional viscose manufacturing in an environmentally friendly manner by reducing the amount of chemicals used, utilization of less water and convert to eco-friendly processes. Other companies are making their viscose more sustainable by using eco-friendly fiber and superior chemical processes.

Modern Usage:

Now viscose has become very common in various usages such as clothes, household wares, healthcare goods and industrial products. These materials are silky in appearance, soft to feel and wearable. The popularity of synthetic fibers did not deprive viscose the right to remain an important textile industry part, due to its sustainability and low cost.

Important events in the history of Viscose:

Cross, Bevan and Beadle invented the viscose process in the year 1892.

1905: Large scale manufacture of viscose was commenced in the UK.

During the 1920s and 1930s rayon becomes more popular as a material used in clothing and other textiles.

Closed-loop processes produced by designers between 1970s and 1980s are as a result of ecology concerns.

21 st Century: There is the helping of the environment with the introduction of viable methods of creating viscose and the introduction of Lyocell.

In conclusion it can be said that viscose fiber was initially a silky substitute which evolved to be a versatile and much-needed product in the fashion market as well as in industrial applications. Currently, it is changing to respond even better to such aspects as sustainability and environmental protection.

2.2 Of Cotton Fabric abouts:

Cotton is derived out of the fiber of cotton plant (Gossypium) and is soft to feel. Cotton is widely used in all parts of the globe due to its ease of processing, comfort and high versatility. It is a close examination of cotton.

1.So what is Cotton?

Cotton is made up on the bolls or the seed pods of cotton plants. Surrounding the seeds is where the fibers are located and it is the fibers that are converted into cotton fabric (and other products) that has been processed.

2. The Culture of Cotton:

As a crop, cotton does well when planted in a warm environment and exposed to a lot of sunshine. Once the flowers dry, they contain the seeds which are covered by pods. As soon as it is mature, the cotton bolls burst open revealing the loosened cotton fibers. The fibers are then collected and the seeds are removed (this process is known as ginning) and the yarn or the thread is obtained.

3. Varieties of Cotton:

Many types of cotton exist and every type has a unique property. Usually, they exist in either of two forms.

- Both in the U.S. and many other areas, upland cotton accounts for most of the cotton crops. Its fibers are quite short but still make the fabric tough and flexible.
- Because Pima fibers are very smooth and long, they are most commonly used to make high-quality sheets and clothing.
- Egyptian Cotton: Like Turkish cotton, it is valued since its strands are long, the fabric feels soft and it is durable; it is commonly found in luxurious hotels and the best kind of bedding.

4. important Features of Cotton:

- Cotton fibers are naturally soft thus, cotton garments are really easy to wear.
- Due to the ability to move air in and out of cotton fibers, this fabric fits in the warm regions because one can achieve a comfortable body temperature.
- Cotton would have a tendency to absorb liquids immensely, which is one of the reasons why it is mostly prevalent in beddings, towels and sports apparel.
- The cotton fabric tends to be hypoallergenic and non irritating to sensitive skin.
- Cotton is strong and durable yet it is easily weakening when left in the sun or using chemicals very regularly.

5. Purposes of Cotton Use:

There are several products made out of cotton, in textile and also outside the textile-vault.

Clothing: Clothing made of cotton is very widely used in the form of t-shirts, jeans, dress and undergarments as cotton is so comfortable and breathable

Bedding: The majority of the sheets, pillowcases as well as the blankets are cotton since cotton is breathable and soft.

Towels and Bath Products: Individuals would like to have towels that are made of cotton as they are able to absorb much water.

Medical Supplies: Cotton has gained popularity in bandages, gauze and any other medical supplies, as it is soft and absorbs fluids.

Cottonseed Products: The cotton plant seeds are the foundation of the manufacture of cottonseed oil that could be found in both cooked and processed foods.

6. Environmental and Social Consideration:

Cotton is a re-growable crop but there is some traditional cultivation of cotton that will cause environmental havoc.

Use of Water: To cultivate cotton, a lot of water is required. Owing to this, individuals in water-scarce areas are concerned.

Pesticides and chemicals: Most of the cotton farmers use pesticides and fertilizers which can harm our environment and also us. Many people have taken to farming organic cotton sans the harmful chemical effects.

Labour conditions: Common report is that workers in the cotton industry have to undergo hard conditions especially in developing nations. Ensuring fair trade and care/sourcing of cotton is currently a top priority among producers.

7. The Cotton Industry:

On a global scale, cotton is grown mainly by China, India, the United States and Pakistan. After processing in textile mills, cotton is used worldwide for clothing, soft goods at home and making industrial products.

8. Sustainability and Cottons:

There is an increased use of sustainable ways to grow cotton. Several ways of making cotton growing more environment friendly are underway.

Organic Cotton: Organic cotton does not harm the environment since it does not utilize any chemicals in the growing process.

Water Conservation: Water resources are conserved because good farming of cotton reduces the amount required in water conservation through drip irrigation and collection of rain water.

Recycled Cotton: Making use of the old cotton and the discarded material helps reduce the number of environmental issues.

9. Importance of Cotton and Ias as Culture:

Human beings have cultivated cotton since thousands of years. Cotton facilitated in the development of economies all over the world particularly during the Industrial Revolution in which cotton mills transformed the manner of clothing production. The cotton has a prominent position in the US history, primarily due to the development of cotton cultivation and commerce contributing to the shaping of the US economy and participating in slave trade in the 18 th and the 19 th century.

10. Cotton vs. Other Fibers:

The comparison of cotton with polyester and other synthetic fibers and such natural fibers as wool or linen is normal. Cotton can breathe, unlike man-made fibers, and it is suitable to people with allergies and dissolves in soil. Still, man made fabrics tend to be wrinkle and long lasting. Wool and linen are warmer as cotton is usually thin and soft.

Generally, cotton has several uses and it is also natural and very beneficial. This has led to the farmers shifting to the sustainable cotton farming style which will ensure that the use of it does not only end this year as a result of the environment challenges.

Cotton yarn

Cotton Fabric

2.2.1 What is jersey Fabric:

The special thing about jersey fabric is that it stretches, is very soft and is known for being comfortable. It is formed by the same knitting method as sweaters which creates a smooth and a slightly bumpy side on the piece. You can find jersey made from cotton or from blends or synthetic material such as polyester.

Primary qualities of Jersey Fabric:

1. Stretchy: The jersey fabric is knit, hence, it is very stretchy giving it comfort as well as ease of movement. It can grow in the horizontal direction and the vertical direction.

2. Soft and Comfortable: Since the soft texture of the material feels good against the skin, it is common in t-shirts, dresses and lounge wears.

3. Light to Medium Weight Jersey is made lightweight or medium weight although thickness may vary as per the application.

4. Breathable: Cotton jersey is breathable enough and removes moisture that makes it appropriate to wear in areas with warm climate and garments that require sporting activities.

5. Drags Well: Jersey is applicable in dresses and skirts due to its easiness in attaining a desired shape.

Common Uses of Jersey Fabric:

T-shirts and Tops: The tops worn by people as teen jerseys are usually simple t-shirts, long sleeve shirts and polo shirts.

Dresses: Jersey is widely used in tightly fitted dresses or comfortable non-fitted dresses as jersey is too soft and elastic.

Activewear Activewear consists of workout clothing, yoga pants and sportswear which is typically produced in jersey due to its ability to stretch and its high breathability.

Loungewear and Pajamas: It is stretchy and comfortable hence it will be used in sleeping and relaxing at home.

Sweatshirts and Hoodies: Jersey Jersey of thick and heavy material is normally selected to be used when making sweatshirts and casual tops.

Types of Jersey Fabric:

Cotton Jersey: Because it is made of cotton, this type is breathable, very soft and is often chosen for casual clothing.

Rayon Jersey: This fabric which consists of rayon fiber, feels like silk and hangs more elegantly than cotton types.

Polyester Jersey: One made from special synthetic fibers that holds its shape, is not heavy and helps keep sweat away from your skin, suitable for sportswear.

Blended Jersey: A blend of cotton and spandex that makes the fabric stretchy and long lasting.

Care Instructions:

It is not so hard to take care of your jersey fabrics. The standard solution of most jersey fabric products is to machine-wash, but it is useful to read the care label. Washing a jersey can be done to prevent stretching of fabrics.

To sum it up, the jersey material is bendable and pleasurably soft and is present in numerous articles of clothing worn everyday as well as during exercises. It is comfortable as it is soft to touch, breathable and can be easily looked after and as such, makes a good everyday outfit.

2.2.2 History of the cotton jersey fabric:

The evolution of cotton jersey fabric is inseparable with the way knit fabric and contemporary attire were brought into the picture. It is time to see the look and evolution of the Cotton jersey fabric to what we have now:

1. Knit fabrics: The beginning:

Age-old Origins: Knitted fabrics made by hand-knitting have existed since ancient times. The initial or some of the earliest knit products were found in Egypt and Middle East and they employed natural materials such as wool and linen.

14 th Century: Socks and stocking in Europe were mainly knit starting in the fifteenth century. However, these earlier materials were not jersey like the modern counterparts since they came in significantly thicker and ruder forms most of the times.

2. The industrial revolution and the creation of the Jersey cloth:

Late 19th Century: Jeremy fabric didn t come into existence until the late 19 th century when there was the entry of the mechanized knitting. Due to industrial revolution, textile production improved a lot, and so was the birth of circular knitting machine. The machine also enabled the use of knit structure making its fabrics to be stretchy and flexible compared to weaved fibers.

Jersey Origin: Jersey, a location in the Channel islands between England and France, was the region which lended their name to jerseys. During the 19th century the island produced a special knitted wool and it was appreciated by fishermen or other people, who required practical clothes. Jerseys were initially made of wool and linen that made people warm and comfortable.

3. Introduced Cotton Jersey (Late 19th To Early 20Th Century):

Popularity of Cotton: High popularity of cotton as a primary fiber during the late 19 th century resulted in the selection of this fiber as cotton jersey fabrics. Cotton is lighter and softer and allows air ventilation through hence suitable to be used in normal and everyday designs.

Early 1900s Cotton jersey became a more frequently used product to apply in the making of underwear, t-shirts and other daily attires. Knitted fabrics were luxurious due to the reason that they are not as firm as woven fabrics making them very comfortable. Jersey fabric was being used in greater numbers in clothing due to the fact that cotton was becoming more readily available even to athletes.

4. The Emergence and Popularity of T-shirts and Casual Wear (Mid-20 th century)

1920s-1930s - A massive breakthrough in cotton jersey fabrics occurred when T-shirts became a popular every-day wear in the USA. During World War I, t-shirts were worn by soldiers underneath the uniforms during the commencement of the war in the first half of the 20 th century. Cotton jersey is airy, and it is comfortable to wear, hence these original t-shirts were made of cotton jersey.

1940s-1950s: At the time the World War II was over, t-shirt became the good thing that people used to wear in the house or outside the house. Now, due to usage of cotton jersey fabric and modern production methods, t-shirts were turned into something that humans could be able to wear daily and not spend a fortune on it.

Cotton jersey Sports: Cotton jersey became popular in the production of athletic clothes and everyday wear around the 20 th century. Due to its ease of wear/stretchiness, it gained popularity in the field of activewears, uniforms and clothing to wear on relaxed occasions.

5. Modern Era Cotton Jersey

Late 20 th Century to the Present Era: The cotton jersey fabric was very popular in several decades following the late 20 th century. Due to its comfort, relaxed and appealing feature, denim has become fairly used in casual clothing like t-shirts, dresses, pajamas and loungewear. It became popular and designers began to make clothing that were fashionable using its softness and stretch.

Blends and Variations: Although cotton jersey has inarguably remained one of the best fabrics to wear because they are both comfortable and easy to maintain, today, most cotton jersey products are mixed with spandex, elastane or polyester which make them stretchy, long lasting, and having the capacity to dry sweat. This is why cotton jersey is one of the preferred fabrics in sports wear, casual styles and everyday street wear.

2.2.3 What is the process of jersey fabric:

The Jersey fabric is manufactured through knitting that locks the yarns together thus making them soft and stretchable. This is what happens at every step:

1. Yarn Selection: To decide what kind of yarn to go with is the initial step. Some of the fibers that are used to create a Jersey are cotton, wool and polyester. The yarn can be thick or fine according to whatever type of texture and weight you need to have in your cloth.

2. knitting: Unlike woven material that intertwines two fibres together, jersey is constructed of one thread that is knit and connected with each other with loops. The needle punches are positioned with the help of one kind of knitting machine. Whichever way you knit, although called single knit and most commonly used as jersey fabric it produces one side which is smooth (the "front" or "right") and one side which is slightly textured (the "back" or "wrong").

3. Stretchability: A major characteristic of jersey material is that it is stretchy. This occurs due to the fact that the set up of the yarn loops in the knitt is different. The fabric is stretchy that makes it more smooth and comfortable and fits to the body due to the fact that it is knitted.

4. Finishing: This stage is applied after knitting in order to improve the appearance of the fabrics, smooth them and to increase their longevity. This may include washing, dyeing or treating clothes with some processes such as softening or wrinkle-resistant.

Thus, jersey fabric is normally lightweight, soft, and of breathable nature that is why it is used in everyday wear clothing and sports clothing such as t-shirts, dresses, and sports apparels**.**

2.2.4 How does jersey fabric apply:

This is because the jersey fabric is so versatile and hence the reason why it is used most in production of various (clothing and accessories). The most popular jersey fabrics applications are as follows:

1. Tops and T-shirts

T-shirt and casual tops are mostly made out of Jersey fabric. People get comfortable in participating in leisure activities and physical activities courtesy of its comfortable softness and stretch-ability of cotton.

2. Skirts and Dresses

This fabric, people wear them by using them as regular casual dresses and skirts. It is elastic as blends fit a bit closely and fall well thus people wear it to form bodycon shapes or loosely-fitted dress.

3. Activewear

Jersey is incredibly stretchy, moisture wicking (that can be done because of the use of blending fabrics like polyester) and thus, it is become considered standard when we refer to active wear (like leggings, exercise tops / sports bra). Yoga pants are elastic and make the wearer comfortable with what he/she is doing, this is why the workout users prefer them.

4. Loungewears and Pajamas

Most of the loungewear, sleepwear and pajamas are made of Jersey fabric. Jersey is soft and breathable, and thus it is an attire worn in comfortable home clothes.

5. Hoodies and Sweatshirts

The Jersey with fleece or cotton is preferred with hoodies and sweatshirts. The reason that they do so is to have elasticity of the fabric so that they can be comfortable as well as warm.

6. Maternity Wear

Jersey is flexible and stretchable hence is used in maternity wear to make the expecting moms, comfortable and well-broadcasted.

7. Undergarments

Jersey fabric is appropriate in making bras, underwear and camisoles because it is soft and smooth**.**

8. Baby and Children Wear

Jersey is often used to manufacture children clothing and kids wardrobe such as onesies, dresses and rompers. Its ability to stretch and be soft implies that it is gentle on the skin of a baby and that it also gives them a lot of mobility.

9. Bedding/ Linens

Jersey is commonly used as bed sheets, including pillowcases and linen goods and a wide-spread knowledge about jersey knit sheets is that they have a t-shirt like comfort.

10. Accessories

It is not a surprise that the jersey fabric may be used in other accessories including scarves, headbands and hats since it is extremely comfy and stretchy.

Majority of the times jersey fits in any type of work and usually jersey is found in many things that require being airy, soft breathable and stretchable and in all kind of clothing.

2.2.5 What is the prices of jersey fabric:

The cost is partly determined by many factors including the type of fibers used, the methods through which the jerseyfabric is made and the market prices among others. The papers mention the primary factors that affect the price of the fabric even though they do not mention the cost in specific.

What determines boxer sweater cost?

Raw Material Composition: The composition of a jersey material is largely what determines the costs of the same. The mixed material cotton with modified cellulose fibers is one of the examples of the propensity that enhance the characteristics of materials during the values of comfortability, breathability, and lower the expense, as stated by Jianguo (2020).

Production Techniques: The techniques in weaving which utilize hydrophobic agents could also affect the price since the production process will be more complex (Takashi, 2019).

Market Dynamics: The cost of the fabric is nearly 50 percent of the whole price of a product in the apparel and it is, therefore, really important to use it so that the manufacturers are competitive (Bilgiç & Baykal, 2017).

In spite of the existence of certain factors that guides the cost of jersey fabric, other fluctuations occurring in the textile and raw materials market may bring fluctuations in jersey fabric price, this is the reason behind manufacturers exercising vigilance in regard to market trends.

2.2.6 There are a lot of various distinctive types of jersey fabric:

Jersey fabric comes in a wide variety of varieties, largely to be distinguished by how they are knit and by materials. Single jersey and double jersey are among the most significant categories since they are classified by different attributes which have an influence on their application during textile manufacturing. These manufacturers and consumers are dependent on being aware of the differences that matter among these pieces.

Jersey Fabric Type

Single Jersey:

The fabric is made using just a single skein of yarn thus it is light and provides elasticity.

It is popular in t-shirts and general wear due to its comfort and the ability to be breathable (Hasnat et al., 2015).

Double Jersey:

It is knit of two or more types of yarn and thus has lovely thick and durable stuff due to its thickness.

One can notice zippers on most sweaters, suits and even sports wear because they keep the wearer warm and supported (Hasnat et al., 2015).

Specialty Jerseys:

T/R Bulky Spandex Jersey- It is polyester, rayon and spandex strongly stretched and blended fabric, which is sturdy, soft and comfortable to different products (Jiefu, 2011).

Although individuals are curious to have these specific fabrics, the advancement of technology and material science continues to influence sugus thereby resulting in jerseys that possess some aspects of classical forms.

2.2.7 What is the environmental effect of jersey fabric?

Being a textile, Jersey fabric does affect the environment and this is highly dependent on the raw materials to be used and also on the process of production. Some of the key points are as follows:

1. **Cotton Jersey:**

   Water Consumption: The normal process of cotton farming would consume a lot of water and results in water scarcity in various areas. Cotton farming in many cases involves the use of pesticides that could be deleterious to nature.

   Organic cotton: Organic cotton is also environmental-friendly. It uses fewer harmful chemicals and water does not require a lot, but it is still very water-intensive.

   Biodegradability: Cotton can be broken down in nature, as it is biodegradable unlike a number of synthetics.

2. **Polyester Jersey:**

   Petroleum-Based: Polyester is manufactured together with the aid of petroleum that is in turn an irreproducible resource. Polyester creating results in carbon emissions.

   Microplastics: Polyester fiber releases microplastics during washing and this can have adverse effects on the sea life.

   Recycled Polyester: In recycled Polyester, r PET (uses plastic waste) textile, the environmental impact, is that old bottles can be recycled into fresh textiles.

3. **Rayon Jersey:**

   Deforestation: In case rayon is produced as a result of wood harvested in unsustainable ways, it can be one of the causes of deforestation. Nevertheless, the situation is not critical when it concerns the products made of sustainable forests or recycled materials.

   Chemical Processing: Processing the rayon using chemicals will pollute the environment in case it is not regulated properly.

4. **Linen Jersey:**

Sustainable Crop: The cotton crops require a lot of water and extra chemicals but linen, which is extracted in flax, requires less pesticides and water. It is perceived by people as a more environmentally sound option.

Biodegradability Like cotton, linen does not remain in the environment, because it is biodegradable.

5. **Wool Jersey:**

Land Use- The production of wool requires land where sheep can graze and the land should be well maintained such that it is not destroyed. Their agriculture also contributes to the amount of gasses that are emitted that are methane gasses.

Sustainability: Wool is generally a relatively environment-friendly output because it can be grown in a sustainable manner.

6. **Spandex/Elastane Jersey**:

Synthetic Material: Because spandex is produced from similar chemicals as polyester, it is concerned about the same pollution and relies on fossil fuel resources, like polyester.

Cotton or linen clothes are not as harsh on the atmosphere, because their climate impact is less than that of synthetic-material clothes. Even among those, factors such as the use of water, the use of pesticides and generation of waste during the process may have enormous implications.

To make a sustainable choice, consider Explore Swedish Barbaric or high-quality organic or recycled; A GOTS (Global Organic Textile Standard) or OEKO -TEX certified product. Is it sustainability, feel or something that matters to you when picking fabric?

2.2.8 Process of manufacturing Cotton Fiber:

The steps in the production of cotton fibers are quite significant to make sure that the fibers are good quality to be used by the textiles. After it takes raw cotton through the removal of impurities, processing of the fibers and finally making the final yarn. Each of these stages is discussed following sections.

Raw Cotton Preparation

Bale Plucking: A bale pucker is used to lift the cotton bales which begins the processing of the material (Hashing, 2021).

Dust and Impurity Removal: Various devices such as those known as mixing cotton slitters and porcupine-type cotton slitters, are used to take out dust and unwanted particles from the fabric in different steps (Hashing, 2021).

Fiber Processing

Carding and Drawing: Carding is applied to cotton after the scutching procedure whereby, the cotton is carded into slivers then drawn to make it as even as possible (Yin et al., 2020).

Spinning: Once the fibers have been drawn, it follows that they are twisted into yarn which keeps the fibers elastic (Yuba, 2019).

Final Production

Winding and Packaging: Then, the spun yarn is placed on bobbins and is to be dispatched elsewhere in the stages (Yibao, 2019). Dust is removed with greater efficiency as static is dealt with with the aid of electric ions in the processing (Yonghua, 2019).

The common mode of manufacturing the cotton fiber is clear-cut, and the application of the newer technology and apparatus continues to make things shorter and even improved as illustrated by the responsiveness of the industry to the new age requirements.

2.2.9 Descriptions of cotton fabric physical properties:

This can be explained by the fact that cotton has handy physical qualities that people prefer it as a clothing material and also in their homes. The key physical characteristic of cotton cloth is as follows, Nedis:

1. Objects that are produced in cotton are smooth in texture so they become comfortable to be worn as clothes or in beddings.

2. Cotton fiber allows the air to penetrate through the cloths which implies that the body maintains a pleasant temperature by absorbing sweat.

3. Cotton is employed in towels, bathrobes and other similar fabrics since it is quite absorbent.

4. Cotton goes resilient in whatever type of moisture, but stronger when it is not moist. When wet, cotton does not remain strong like other synthetic materials.

5. Cotton is wearable and this means that it may disintegrate slowly due to several factors such as heat, sun rays, chemicals and friction among others.

6. Elasticity: cotton is not an elastic material so the cotton-made item could lose its shape because of constant usage or pressure.

7. Cotton fabric does not retain its heat against the skin and this is moderate in its heat conducting capacity, which is useful in keeping the body temperature down.

8. Cotton is frequently chosen due to its comfortability because it does not produce static electricity as many of the synthetic fibers do.

9. Shrinkage issue: Cotton is also likely to shrink after it has been washed; therefore, you need to be careful when washing the clothes.

10. Color Retention: After dyeing has taken place, cotton takes in color quite well and with time it might begin to fade due to excessive cleaning or exposure to sun.

The many good qualities of cotton fabric make it applicable in a lot of ways though it has to be maintained well to stand the test of time.

2.2.10 Cotton fabric Chemical Properties:

Many of the chemical features of cotton are undergoing in its processing use, and treatment and in the way it carries out. The cotton fabric has some of the most important chemical properties as follows:

1. **Cellulose Composition:** cotton mainly consists of cellulose, which is a natural polymer. Cotton is tough, absorbent effect and is easily degradable owing to its cellulose presence. Cotton consists largely of cellulose that constitutes the larger portion of it.
2. **Reactivity Alkalis-** Sodium Hydroxide and other like chemicals are capable of reacting to cotton and is known as reactivity of alkalis. Be cautious on a cotton wearing it when subjecting to alkaline detergent and bleach because they are able to weaken.
3. **Reaction to Acids:** Little is normally damaged when weak acidic solutions are exposed to cotton, however stronger acids (specially sulfuric acid) dissolve the fiber of the cotton and therefore this makes it weaker. Cotton is susceptible to acidic materials after some time, however, it can withstand more than several man-made fabrics.
4. **Moisture Absorption:** cotton is highly hydrophilic and therefore it absorbs moisture very well. On this account, cotton is a nice absorbent which is often observed in towels, bed linens etc.

5. Biodegradability: Cellulose, the material of which cotton is made, is biodegradable in nature whereas the corresponding synthetics last an extremely long period.

6. Flammability: Cotton can burn faster when compared to a few synthetic materials but it requires a long time before getting fire. Cotton ordinarily burns with a visible flame and leaves huge ash. The risk of fire in the case of wool is higher than that of plastic materials but it is rather safe.

7. Dyeability: Cotton does not resist dyes especially natural and synthetic. It accepts color and retains well, but the situation could be different when washing or under the sun.

8. Willingness to Oxidate: As cotton is worn out, it tends to oxidate especially when exposed to sun light and air. Such as old ones such as cotton sheets and clothes.

9. Resistance to microorganisms: Since cotton is natural, it will be able to attract mold, mildew and bacteria much better in the event of it being wet or humid. When cotton is exposed to water, it has to be dried thoroughly.

These chemical traits cause cotton to change according to its surroundings and to change with washing, aging and regular wear. Cooling and suiting the garments with natural or organic detergents help them stay preserved for a longer time.

2.2.11 Sequence of process of dyeing cotton with reactive dyes:

Preserved samples collection

↓

Estimated water level

↓

Add leveling agent

↓

Drops in dye solution

↓

pour in salt solution

↓

Add soda ash solution

↓

The temperature Increase to 600C

↓

30 min Run time

↓

Bath drop

↓

Rinsing

↓

900C 10 min hot wash

↓

Dry

Chapter-three

3.Experimental Details:

3.1 Material & Method:

Material:

100% Viscose and 100% cotton single jersey knitted fabric collected from a local fabric processing factory (Knit Concern Group) which is scoured and bleached with a standard bleaching recipe.

The other chemicals used in this experiment e.g. wetting agent, sequestering agent, and detergent were collected from a local chemical supplier AR Chroma Singapore Pte. Ltd whereas Glauber's salt, sodium hydroxide, and sodium carbonate are used in this.

The dyeing was carried out in 1KG FONG'S ALLFIT Sample dyeing machine, in China.

Method:

All two fabrics (Cotton and viscose) were pretreated according to recipe Table 1 (combined scouring-bleaching recipe for cotton) in these cases whereas mild scouring is sufficient to remove the possible dust, dirt, or spin finish chemicals that adhere on these two fibers.

These two fabrics were dyed with a bifunctional recipe Table 2

1. SYNO-YELLOW-KHL
2. SUNFIX-RED-SPD
3. SYNO-BLUE-KHL

3.2 Water:

Assessment of water consumption during the process of sustainable bi-functional reactive dyeing of cotton and viscose and the possibility of limiting this use to obtain good colors is part of what engaged this assessment. Using bi-functional reactive dyes, the covalent bonds are created in a much more direct manner, and this leads to the necessity to use less amounts of water and chemicals when dyeing. The common applications of water and their treatment by sustainable dyeing are given below.

1. Bi- functionality of Reactive Dyed Process:

Water Consumption: Bi-functional reactive dyes have two reactive points which results in a more efficient and stable bond to cotton and viscose fiber. Therefore, the dyes might only require single rinse cycle meaning that there will be a saving of water. The water consumption at my dyeing process was 160 liter.

Water Efficiency: Water efficiency can be achieved because the bi-functional dyes adhere to the fabric in a better way eliminating wastage or runoff of dyes. Since the consumers are consuming less soap, during the rinsing, it requires less water to be used. It is of great assistance in reducing water pollution and consumption.

Pollution Prevention: When more of the chemicals used and the dyes are retained firmly in the fabric they are used in much less of the used chemicals and dyes are released into the nature. This results in a cleaner and, more ecological dyeing technique.

Applying bi-functional reactive dyes while dyeing cotton and viscose products greatly lowers water usage and pollution. To help achieve a greener environment, these dyes improve how dyes stay on fabrics, lower the required amount of water for washing and include water recycling. Checking how much water and how many chemicals are needed for dyeing helps to evaluate if your manufacturing is sustainable and can be improved.

3.3 Popularity of reactive dye:

Many reasons have made the textile industry start preferring reactive dyes. They are so known and used because they are better to dye. These are the greatest reasons why the reactive dyes have become very popular:

1. high Color Fastness:

Wash Fastness: The good wash fastness is an attribute which is a characteristic of reactive dyes. The reason as to why it is the color that cannot be easily washed off such as the time we are washing these clothes as compared to that of red one that is used to decorate the other clothes is that the dye and the fibre are bonded together by covalent bonding.

Light Fastness: Good light fastness is brought about by the light resistance reactive dyes.

2. Bright and Vivid Colors:

These dyes are famous for making bright and colorful shades of dye such as bright red, blue, yellow, green and other shades. As a result, they are popular. choice for creating Useful examples like clothing, furnishings and many others.

3. It is environmentally friendly as compared to others in using this dye.

Reactive dyes create minimal environmental issues as compared to azo dyes. Harmfulness of fewer chemicals to use and inability of almost everything to break ensures that the water

sources are not polluted so easily.

Most of reacting dyes are assumed safer as compared to other synthetic dyes but this depends on the chemical formula.

Compared to the normal dyeing processes, most reactive dyes are likely to produce less pollutants thus enabling them to cause less pollution to the environment.

4. Cost-Effective:

Efficiency: Reactive dyes are highly bonded to the fibers hence save the dye. Ultimately, their use may be more economical as compared with other types of dyes, which pose a larger demand on the use of chemicals.

Ease of Application: Reactive dyes are easy to use and normally would not entail complex processes hence no waste of time and labor.

6. High-Quality Finish:

The fabric with the reactive dyes gives a soft tough surface that is desirable in clothing and textile. Use of dye that is in addition chemically combined with the fibers does not affect the cloth feel negatively.

7. The Fashion

Sustainability trend: As more sustainable solutions are chosen in the fashion sector, reactive dyes have been chosen since they are effective and increase environmental sustainability.

Customer preferences: The fact that reactive dyes give the product bright and durable color corresponds to the customer expectations of what he or she expects in his or her clothes.

8. Special Effect:

They are preferred in fashion design to fit the particular designs as they may be created with the use of gradient, tie dye and special colors blends.

They are also known to manufacture tailored colors among other shades which has been seen as the reason behind their popularity in the fancy textiles of the fashion industry.

9.Ordinary used in Textile Industry:

Reactive dyes are very popular as dyes on cotton, wool and silk and synthetic blend. They are trendy in such industries as the utilization of: because they remain colored in good condition and the industry may manufacture numerous things through them.

Clothing: Not only you will find reactive dyes at every garment manufacturing plant, but even in a shop that specializes in executing high end clothing, dyes will be used.

Home Textiles: The sources of natural bedroom and bathroom colors are found in the reactive dyes and hence; bedding, towels, drapes and furnishing are colorfast as well as comfortable.

Sportswear and Activewear: Due to the reactive dyes, the colors of this fabrics remain rich and durable.

10. The quality of a textile can be determined. How.

Reactive dyes are chosen since they are environmentally friendly given the fact that the majority of the population is nowadays knowledgeable on the environmental and ethical impacts of dyes.

Challenges:

Even as reactive dyes are wanted by many, some issues still exist with them.

Because textile dyeing requires a huge water supply, there are issues with it in dry areas. Although reactive dyes give off less wastewater than others, the water should be properly treated to protect nature.

3.4 Classification of reactive dyes:

Reactive dyes are divided based on what they are made of, where their color comes from and the reaction group they have. With this kind of classification, we understand their behavior and how they work with dyes. Following, this topic will explain the main ways we categorize reactive dyes.

Cluster using the Chromophore

Azo Dyes: Chemical structure tends to be the cause of the dyes being less light resistant (Thiagarajan & naranjilla, 2014).

Metal Complex Dyes: Owing to the fact that they can resist tough lighting, these dyes are normally applied in areas that require concentrating (Thiagarajan & Naranjilla, 2014).

Anthraquinone Dyes: This type of dyes which is similar to metal complex dyes, provides a satisfying output when applied in light as well as it can be used with a variety of fabrics (Thiagarajan & Naranjilla, 2014).

Reactive groups classification:

Monomer Dyes: This kind of dye is characterized by having some specialized units that can be combined in some aspects like intense color and washable characteristics (2017, Weeping et al.).

Composites of Cyanurate Coupling: These assist in preparation of hot brand bisabol reactive dyes that can be used to treat silk, wool and cotton (Patel and Patel, 2024).

As such, through the solubilizing group

Sodium Salt of Sulphonic or Carboxylic Acid: The chemicals enhance improved solubility of reactive dyes yet they do not make much difference to the routine of stability of dyes to light (Thiagarajan & Naranjilla, 2014).

Even despite the popularity of the reactive dyes, which are considered easy to apply and remain sturdy on the fabric, their behavior is largely dependent on the manner it was created. Since all textiles assume distinct needs, selection of the proper dye is of great importance.

3.5 On the basis of dyeing temperature:

Reactive dyes can be split into reactive dyes meant to be used at different temperatures, known as cold brand and hot brand reactive dyes. The main point that separates them is the amount of heat needed for dyeing and setting the dye in the fabric.

1. Cold Brand Reactive Dyes:

You can rely on these dyes to react at simple room temperatures or close to them (sparingly above 30°C). Less energy is used because cold brand reactive dyes do not need very hot temperatures when applied to cellulosic fibers such as cotton.

Key Features of Cold Brand Reactive Dyes

Dyeing Temperature They can be put into use with no need for temperature fluctuation such as room temperature.

Application Method Can be used by exhaust dyeing, pad-batch or directly applying on the fabric.

Fixation Room temperature dye fixing means they can be used for simpler dyeing that does not require high heat.

Advantages

Because you don't need to use high heat, energy costs go down.
Their ecological impact is lower since they spend less power on heating.
It takes less time and effort to complete an application.

Examples Examples of vinyl sulphone or Mon chlorotriazine reactive dyes in use are Remazol, Phocion MX and Cibacron.

Disadvantages:

- Brand dyes tend to produce less color than the hot brands can produce.
- Wash Results: Even though washing results are satisfying, they do not quite meet the standards of hot brand dyes.

2. Hot Brand Reactive Dyes:

It is necessary to heat the dyes to between 60°C and 80°C for them to attach to the fabric. They are necessary in high-temperature processes, for example, in high-temperature dyeing.

Main Characteristics of Hot Brand Reactive Dyes

- 50° Celsius is not always enough to ensure top results; you should set the dyeing temperature to around 60° – 80°C for better and quicker results.
- Hot pad-batch dyeing along with exhaust dyeing at high temperatures and heat-based methods is done using hot brand reactive dyes.
- Fixation should be carried out under heat so that the dye reaches deep into the pipe and sticks to **it.**

Advantages:

- It is better to wash hot brand reactive dyes, since they tend to keep the color more securely than cold brand dyes.
- Oil colors are known for making painters' colors deeper and bolder.
- Working fast: At higher temperatures, fixing the parts becomes speedier which helps mass production.

Leva fix, Cibacron F and Remazol HF are three such dyes, since they are built from chlorotriazine or cyanuric chloride.

Disadvantages:

- Heating the bath during dye printing requires extra energy to be used.
- Air drying should not be done with delicate items because they might be damaged or shrink if they come in contact with hot air.
- Getting the correct temperature and cooking time is a difficult task for learners.

Summary of Differences:

Property	**Cold Brand Reactive Dyes**	**Hot Brand Reactive Dyes**
Dyeing Temperature	The temperature should be between 20 and 30 degrees.	Elevated temperatures should be kept between 60 and 80 degrees.
Fixation Method	Acts and corrects problems at normal room temperature.	Heat is needed in the process to ensure the dye sticks to the textile.
Energy Consumption	The weather is too mild, so there is no need to turn on the heating.	This type requires heating of the solution in which dyeing takes place.
Color Intensity	Most of the time, sports are not very intense	Colors that are more powerful and eye-catching
Application Process	Making and serving the food goes faster and easier.	Sales people must have better control and more time.

Property	Cold Brand Reactive Dyes	Hot Brand Reactive Dyes
Wash Fastness	It reaches the standard but is slightly lower than the brand's own hot label.	This is excellent for cotton fabrics in particular.
Examples	The Phocion MX, Remazol and Cibacron dyes are examples of metal-complex dyes.	There are two options to try, Leva fix and Remazol HF or Cibacron F.

Table 3.5: cold & hot brand reactive dyes

The cold brand reactive dyes have become very popular with their advantages that are energy saving, can be used at room temperature, predictable color fastness and easy process on cellulosic fiber. Brand reactive dyes are excellent in making deep longer lasting colors and you should only use them when your process will tolerate the hot temperatures because brand reactive dyes need high temperatures to work.

3.6 Reactive dye mechanism of dyeing:

Dye molecules and cellulosic fibers (almost invariably) connect in a complex inter-relationship in the course of reactive dyeing. Hydroxyl groups present on fibers reacting with reactive dyes develop covalents and the colors developed are very bright and durable. It may occur under minimal heat thus making it more efficient, and environmental friendly. Essentially, the machine works on the following important features.

Mechanism of Bonding:

- Reactive dyes react with the hydroxyl groups in cellulose using nucleophilic substitution or addition reactions and attach to the fibers with a covalent bond (Prus et al,2022) ("Reactive Dye and Its Advancements", 2022).
- Adding cationic groups onto cellulose makes cellulose fibers attracted to negatively charged dyes without the need for salt substances (Prus et al., 2022).

Dyeing Process:

- Pretreatment, dyeing, fixing and after-treatment are the usual steps in dyeing and these processes can be improved to enhance how efficiently they work (Jianlong, 2015).
- On average, reactive dyes use about two-thirds of the dye, making handling and wastewater situation harder ("Reactive Dye and Its Advancements", 2022).

Environmental Considerations:

The salt applied in conventional procedures of dyes production results in the generation of significant quantities of wastewater that explains the development of sustainable dyeing techniques ("Reactive Dye and Its Advancements", 2022).

Though the reactive dyes are powerful and are able to produce intense colours, the increasing awareness of environmental problem demands that studies on the more environmentally friendly methods of dyeing are maintained.

3.7 Important factors for dyeing cellulosic fiber with cold brand reactive dye in batching process:

The success and quality of dyeing cellulosic fibers (including cotton, linen and rayon) with cold brand reactive dyes depends on a few important factors mainly used in the batching process. These include

1. dyeing Bath pH

Under an alkaline solution, reactive dyes have the greatest attraction to fibers. In the majority of cases, pH ranging between 9 and 11 is chosen.

The most common way of adjusting the pH is an addition of sodium carbonate (soda ash) or a similar type of chemical.

The correct pH is required in the case of good dye fixation.

2. Temperature

Cold brand reactive dyes require less-high temperatures (approximately 25 40) and require less heating than normal reactive dyes.

Dyeing can be performed at normal or slightly increased temperatures, but it is possible that when the higher temperatures are used, the process becomes rather faster and attains better fixation.

3. Bath-time (Tea-time)

The amount of time between dye and cellulose is also sufficient thus the dye is not loosely incorporated.

The average may be anywhere between 6 hours to 24 hours and this varies depending on the fiber, dye and how rich the colour needed to be.

Whereas time durations are not necessarily the causes of the colors to stick, longer hours of time can result to the use of more water and energy and extra efforts.

4. Dye concentrations

The depth of a print is related to the level of use of dye. When a coloring is applied in large quantities, it is darker.

The fabric dye should be right in accordance to its weight and the color in which you need.

5. Salt and Alkali Addition

Salt (usually in the form of sodium chloride) is normally used with the dye to aid penetration of the dye evenly and very deep into the fiber.

PH is maintained by adding alkali agents (soda ash etc) and this enables the dye to react effectively with the fiber.

The amount of salt and alkali you are using should also be monitored so that the cloth can be firmly attached and so that the dye should not give killing colors.

6. Water Quality

Water must be of good quality in dying since hardness, iron, and other impurities could make coloring vary from item to item.
Usually, people prefer water that is soft or demineralized.

7. Fixation Agent

Usually, the dyeing process is followed by a fixation step, so the dye sticks well to the fiber. This may occur when you apply a fixing agent or conduct a different treatment process after you dye the garments.
Fixation might be affected by the pH, temperature, and the amount of time involved.

8. Fabric Preparation

Scouring and bleaching aid in removing oils, waxes and filth off the fabric in order that it can dye successfully.

The old chemicals left after the old treatments should be well tidied up.

9. Fiber Moisture Content

The degree of moisture in the fabric affects the amount of dye picked up by the fabric. Optimizing how much moisture is in the fiber is necessary since it can shape the uniformity of dyeing.

10. Dye-Fiber Affinity

The connection between the dye's properties and those of the fiber should be considered as well. Cold brand reactive dyes are selected because they can bind to cellulosic fibers using less heat.
Different kinds of fiber such as cotton or rayon can influence how the dye will behave with it.

Proper management of the mentioned factors allows you to use cold brand reactive dyes on cellulosic fibers and achieve a high yield with great wash-fastness and an even result.

3.8 Sample Dyeing Machine:

Figure 3.8: Sample Dyeing Machine

- Sample Machine No-29
- Capacity : (01 kg)
- Model : ALLFIT-1
- China : Brand
- Origin : Fong
- Comm. year : 2015

The dyeing machines manufactured in China were created with creative features to improve how efficiently and effectively dyeing is done. Some of the features of these machines are improved ways of heating, the ability to change colors, and special designs for various dyeing processes.

fong's textiles are well-known for producing dyeing equipment, mostly related to the textile market. They provide many machines for dyeing and finishing textiles, such as jet dyeing machines, package dyeing machines, among others. Many people know their products for being both efficient, innovative, and sustainable.

3.9 Pre-Treatment:

Recipe of combined scouring and bleaching of cotton & Viscose fabric.

SCOURING-100X30MIN	Antifoam	HT-3A	0.2g/l	16gm
	Ant crease	WN9R	1.0g/l	80gm
	Detergent	PCLF	0.5g/l	40gm
	Sequester	2UD	0.5g/l	40gm
	Stabilizer	SOF HT LIQ	0.4g/l	32gm
	Basic	SODA ASH	3.0g/l	240gm
	Basic	Hydrogen Peroxide	3.0g/l	240gm
80X10MIN	Neutralizer	Siri NE	0.5g/l	40gm
60X10MIN	Acid	Acetic Acid	0.5g/l	40gm
	Peroxide. Killer	SAP	0.6g/l	48gm

Table 3.9: Pre-Treatment

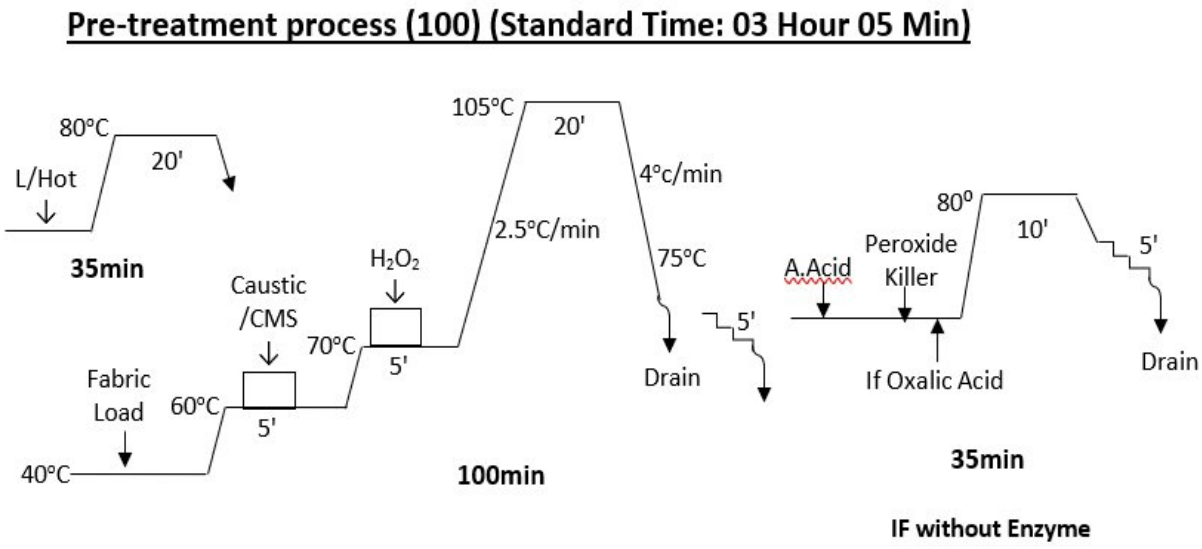


Figure 3.9: Pre-Treatment Process

3.10 Dyeing:

Recipe of combined Dyeing cotton & Viscose fabric with bi functional reactive dye.

Dye-bath	Antifoam	HT-3A	0.2g/l	16gm
	Ant crease	WN SR LIQ	1.0g/l	80gm
	leveling	DSR	0.13g/l	10.4gm
	Sp. leveling	E3R	0.5g/l	40gm
	Basic	Glauber Salt	17.0g/l	1360gm
	Basic	Soda Ash	1.0g/l	80gm
	Basic	Soda Ash	10.0g/l	800gm
Dye	SYNO-YELLOW-KHL		0.0396%	0.792gm
	SUNFIX-RED-SPD		1.9400%	38.800gm
	SYNO-BLUE-KHL		0.0004%	0.008gm

Table 3.10: Dyeing

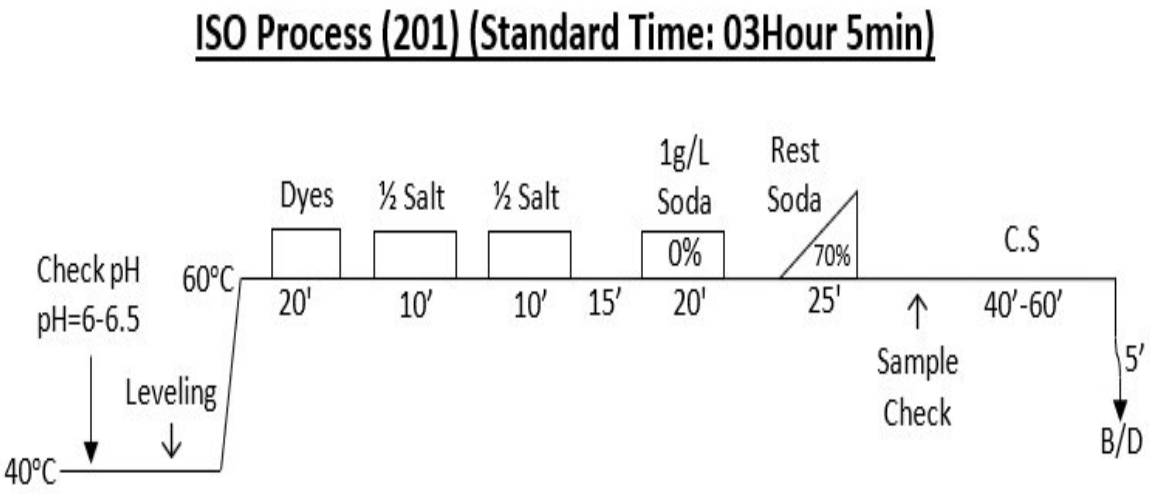


Figure 3.10: Dyeing process

3.11 After Treatment:

Wash-off recipe

After-treatment	Neutralizer	Acetic Acid	1.0 g/l	80gm
	Soaping	SEL	0.5 g/l	40gm
	Soaping	SEL	0.5 g/l	40gm
	fixing	Opti fix RSL	1.0 g/l	80gm

Table 3.11: After Treatment

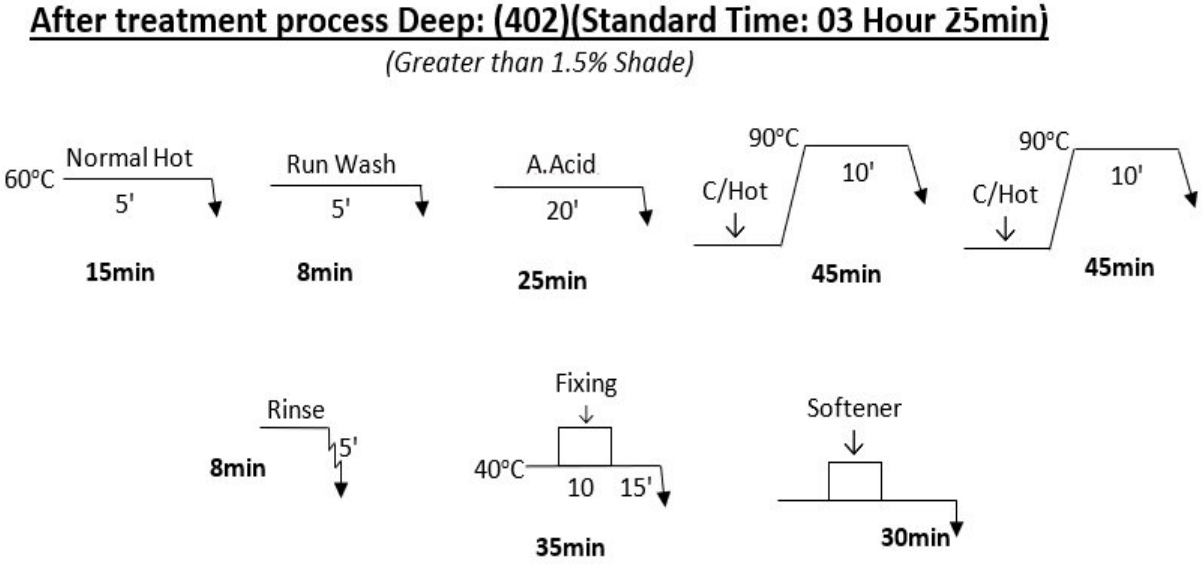


Figure 3.11: After Treatment process

3.12 Finishing Stenter Machine

A stenter machine is the main device for drying and setting the dimensions of fabrics. The drying process on this machine is essential to getting the right quality, look, and performance out of the fabric after its dyeing, printing, etc.

The Important Role of a Stenter machine

Stretching In this technique, the material is stretched until it gets to the correct width and is the same all the way. The machine employed by the device makes sure that the cloth does not become smaller or dedistorted due to the process of ironing.

When the fabric is dyed or chemically treated it should be dried. The appearance of hot air within the stenter dryer assists, in fixing the dye, so that there may be prevention of leaking and running of the dye.

By applying Fixing It, colors or prints remain there and do not wash off after numerous washes. It is quite crucial to note that they are very important in the case of reactive dyes and print on textiles.

The heat setting operation of textiles (such as synthetic, for example polyester) using a stenter machine aids to help fix and set the fibers to a stable point where they no longer shrink and retain their shape.

Working Principle:

First om all, the fabric is rolled on the stenter, with the help of a roller feed that feeds in the machine.

They fasten the ends of the tissues to a tube, on a machine, with pins or clips and then leisurely, expose the edges through the machine.

Heating chamber: By passing the hot air on the machine, the material is heated in order to get it dry and harden it.

The way the stenter operates makes it possible that the breadth of the material can be changed and retained up to the preferred shape owing to cutting and mechanical expansion.

The cloth is slapped and placed in a cooling chamber where the material is rolled to have a finishing shape and dimension**.**

Other types of Stenter Machines:

1. Single Chamber Stenter; This has a single block of heat source and is used with materials dried and set in moderate heat.

2. There are several temperature rooms in this kind of stenter to provide improved changes to drying and treatment of various fabrics.

Key Features:

The stenter machine allows the temperature to be controlled so that the fabric is not harmed during treatment.

It is possible to set the fabric’s velocity through the tunnel, so the heat inside is optimized for how much time is needed for its drying and finishing.

Edge control is used, so the sides of the fabric are managed as it enters the stenter and kept even all the way through.

Applications:

The margarine dyeing and printing of fabric are then encompassed with drying and setting of the fabric. The stenter machine assures that the colored and printed fabric remains unchanged.

Last Step: Product manufactured with fabrics that are beaten waterproof, wrinkle free or flame resistant are completed in a stenter machine.

It is convenient to set heat different fabrics that require particular temperatures, especially when it comes to synthetic material (polyester, nylon, and acrylic).

In simple terms, the stenter machine comes in handy in the finishing of textiles since it enables the textiles to maintain a certain form, similar color all over and they are ready to be transformed into finished products such as clothes and furniture.

Figure 3.12: Stenter machine

3.12: Stenter machine

- **STENTER MACHINE-04**
- **MODEL : Power fra.VN SEP 24/8**
- **BRAND : BRUCKNER**
- **ORIGIN : GERMANY**
- **MAX. Roll DIA : 2600mm (102 inch)**
- **MAX. FAB DIA : 2400mm (94 inch)**
- **COMM.YEAR : 2014**

The last dyeing fabric procedures include fixing the dye and making the fabric more attractive and useful. After the death process; post death processes such as finishing needs to be done so that the fabric can be ready to be used regardless of whether intended to be used in making clothes, furnishing or any other purposes.

3.13 Chemical Process:

- **White Softener : 150-200g/l**
- **Color Softener**
- **Phenolic : 10 g/l**
- **Water : 100-150 Liter**
- **PH : 4-4.5**
- **Pedder Pressure : 2-3**
- **Sun silk : 30 g/l**

1.White Softener: In the textile business, white softener helps make fabrics softer, improves their feel to the touch, and boosts their texture. When using a stenter machine, usually white softener is applied in the last process to help the fabric feel nice and smooth after dyeing or treatment.

2.Color Softener: A color softener is meant to make fabrics softer and look and feel better, all without fading their color. In the stenter machine operation, the color softener joins forces with other treatments to make colors brighter and keep them from bleeding.

3.Phenolic: Using phenolic-based compounds is sometimes done in dye fixation to assist in keeping colors from washing off. The presence of these compounds makes sure the dye becomes stronger and less likely to fade or leave stains.

4.Water: During padding, fabric goes through a container with both water and chemicals that include softeners, dye, or finishing materials. Having water in the process helps chemicals mix well and be applied evenly to the fabric.

Usually, after padding, the fabric goes through rollers to take out extra liquid before entering the stenter machine.

5.PH: Potential of hydrogen (pH) level in the treatment water is an essential factor affecting the chemical efficiency used in the finishing processes of textiles. The pH in a stenter machine plays a big role since it determines how the chemicals used on the fabric perform. The hue, softness, strength of its fibers, and overall appearance of the fabric might be affected by the pH of the dye bath.

6.Sun silk: Having been softened and finished, the fabric goes into the drying chamber of the stenter machine. When the fabric dries, it gets rid of extra moisture and allows it to reach the appropriate softness and flexibility.

Chapter-Four

4.Result and Discussion:

4.1 Shrinkage for Single jersey (Viscose)

Length:				
	B/W (cm)	A/W (cm)	Diff. (cm)	Diff. (%)
1	50	48.0	-2.0	-4.00%
2	50	48.0	-2.0	-4.00%
Width:				
1	50	48.0	-2.0	-4.00%
2	50	48.0	-2.0	-4.00%
Twisting: 2.05%				

Table 4.1: Shrinkage for Single jersey (Viscose)

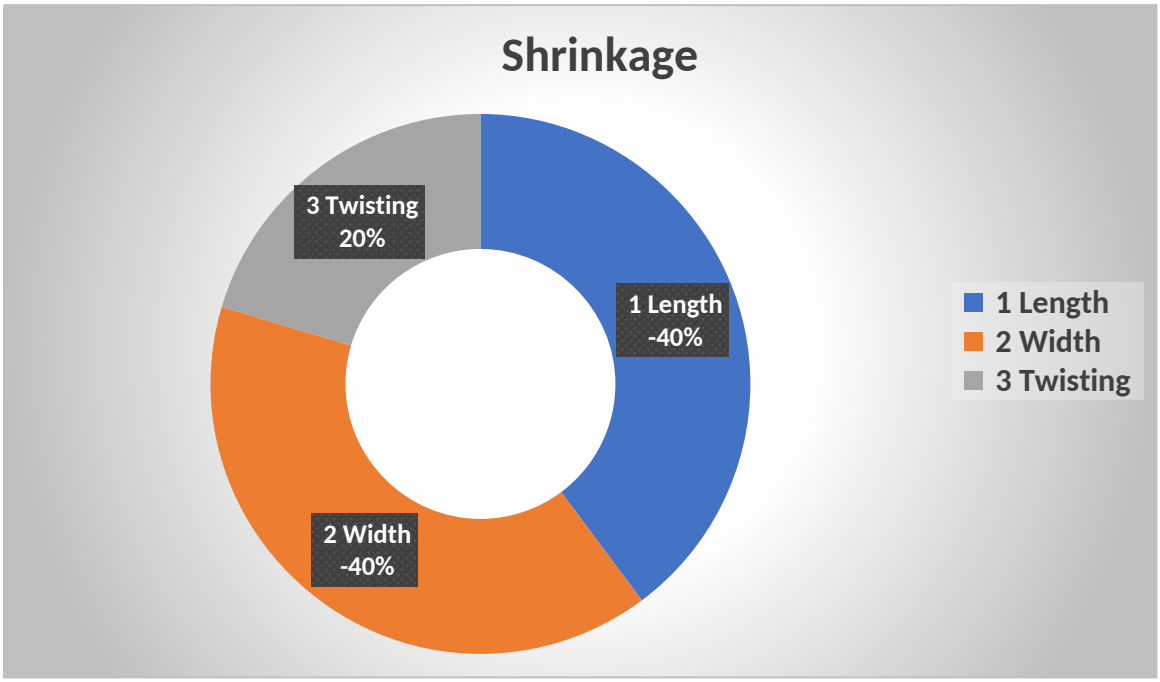


Figure 4.1: Shrinkage for Single jersey (Viscose)

If a material becomes smaller or misshapen after any kind of heat or moisture, it is called shrinkage. How well fiber blends perform and their quality can be affected by shrinkage differently, depending on what kinds of fiber are in the blend.

H&M accept a shrinkage of up to 3% for woven garments and 5% for knits/ jerseys. I found the Shrinkage -4.00% out of (5%) for both Length and width. I am also found twisting 2.05% out of 5%.\

4.2 Shrinkage for Single jersey (Cotton)

Length:				
	B/W (cm)	A/1W (cm)	Diff. (cm)	Diff. (%)
1	50	49.5	-5.0	-1.00%
2	50	49.5	-5.0	-1.00%
Width:				
1	50	48.0	-2.0	-4.00%
2	50	48.0	-2.0	-4.00%
Twisting: 4.66%				

Table 4.2: Shrinkage for Single jersey (Cotton)

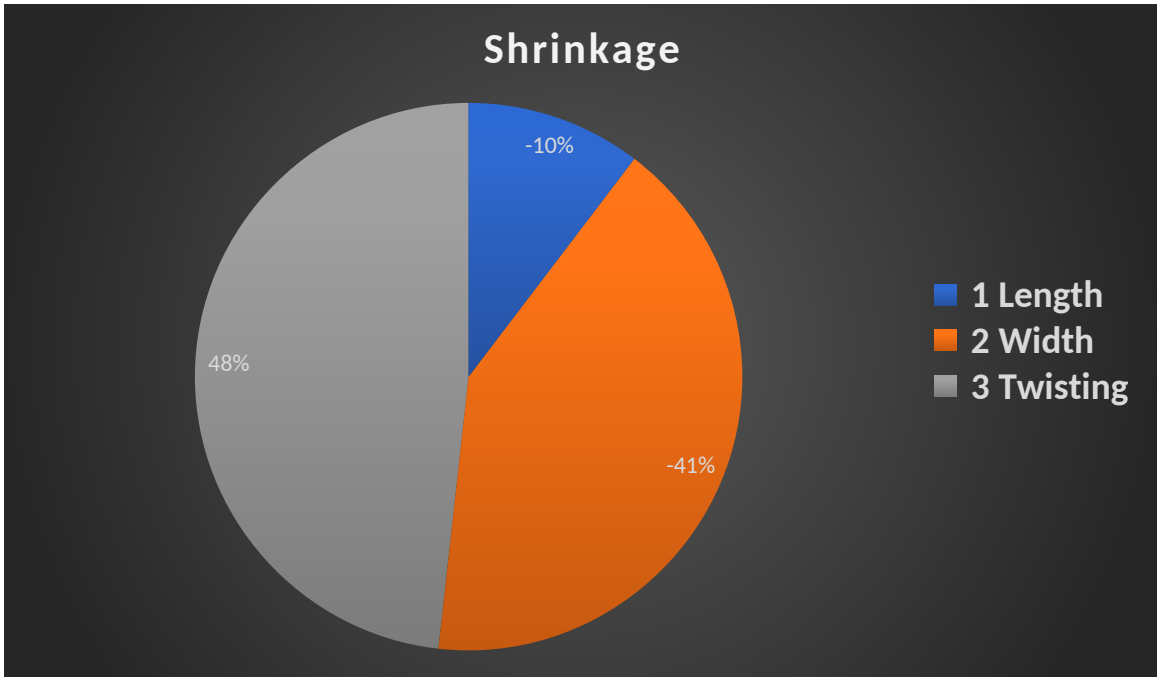


Figure 4.2: Shrinkage for Single jersey (Cotton)

H&M accept a shrinkage of up to 3% for woven garments and 5% for knits/ jerseys. To avoid shrinkage, certain items might need ironing after washes, to regain their original shape and fit. I found the Shrinkage -1.00% out of (5%) for Length and width found -4.00% out of (5%). I am also found twisting 2.05% out of 5%.

4.3 Reflectance:

Reflectance %		
Fabric	**Pre-treated**	**Dyed**
Cotton	78	17.25
Viscose	78.13	7.92

Table 4.3: Reflectance

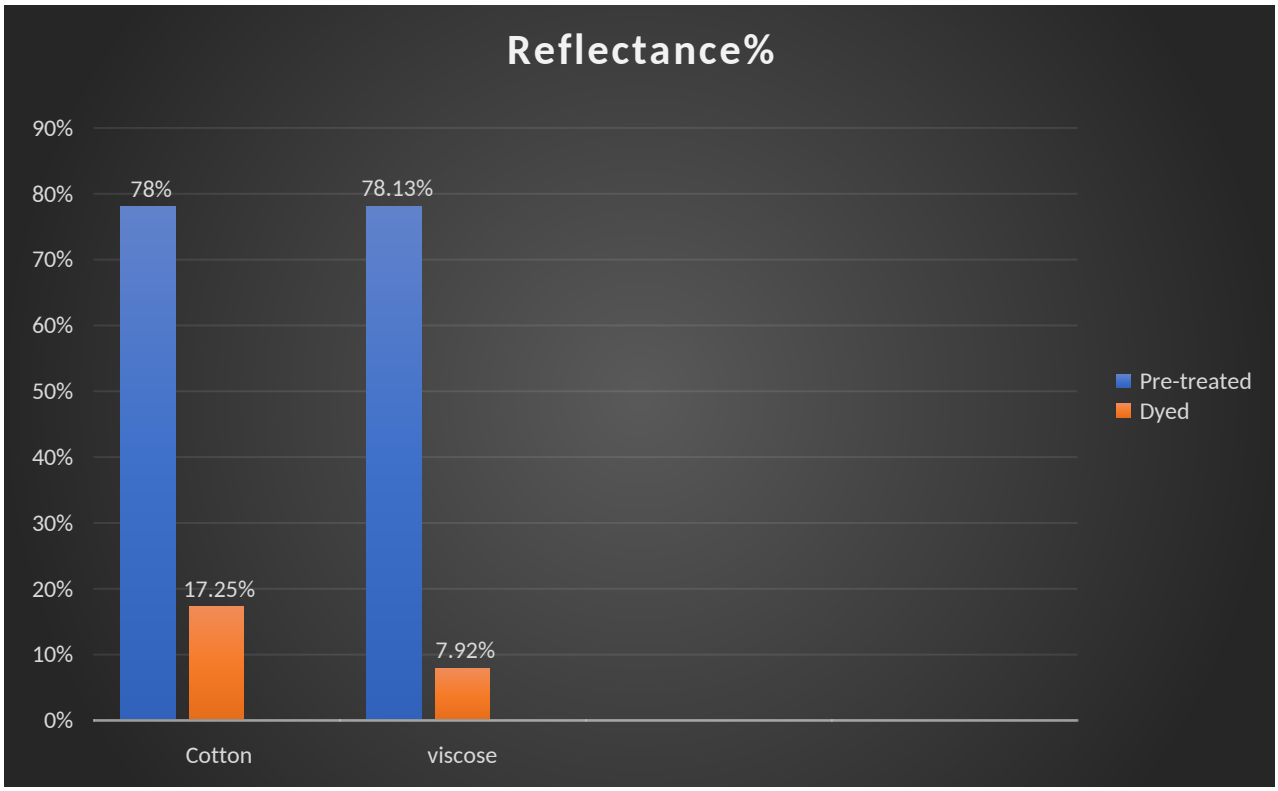


Figure 4.3: Reflectance

From figure it is clear that reflectance % is reduced by 78% after dyeing in case of cotton, however, for viscose it is 90%. That means reflectance % is 54% less than cotton for viscose.

4.4 Fastness:

Fastness	Condition	Cotton	Viscose
Wash		4-5	4
Rubbing	Dry	4-5	4-5
	Wet	3-4	3
Perspiration	Acid	4-5	4-5
	Alkali	4-5	4-5
Light		3	4-5
Water		4-5	4-5
Saliva		4-5	4-5

Table 4.4: Fastness

4.5 Color Fastness to wash:

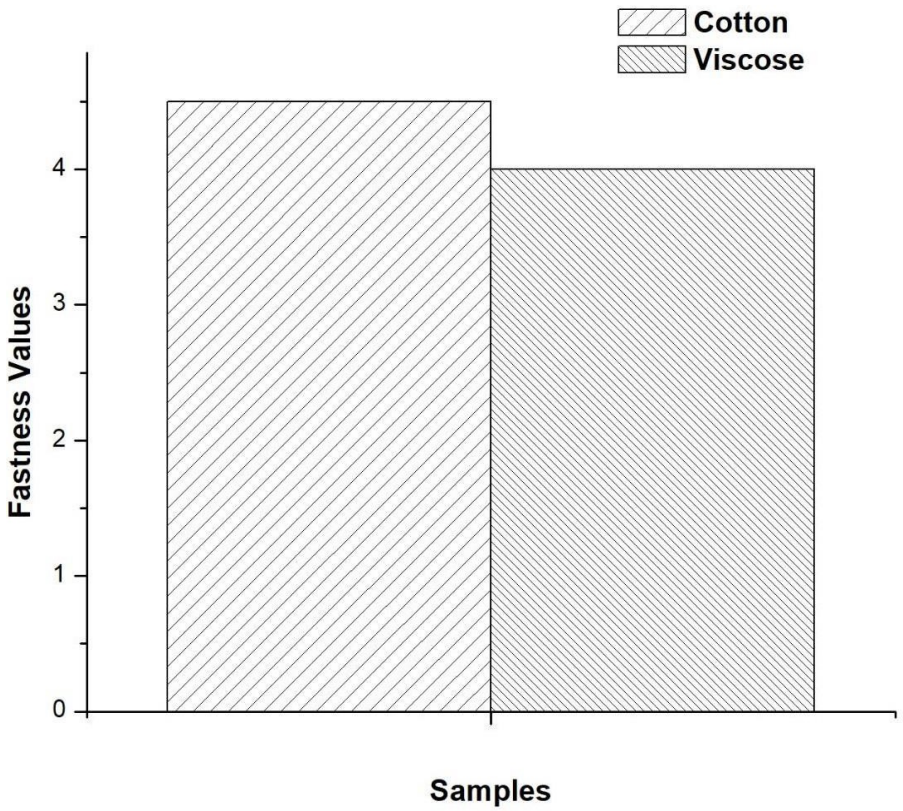


Figure 4.5: Color Fastness to wash.

From figure 2, for cotton, fastness to wash is very good (4-5) whereas for viscose it is good (4).

4.6 Color Fastness to Rubbing:

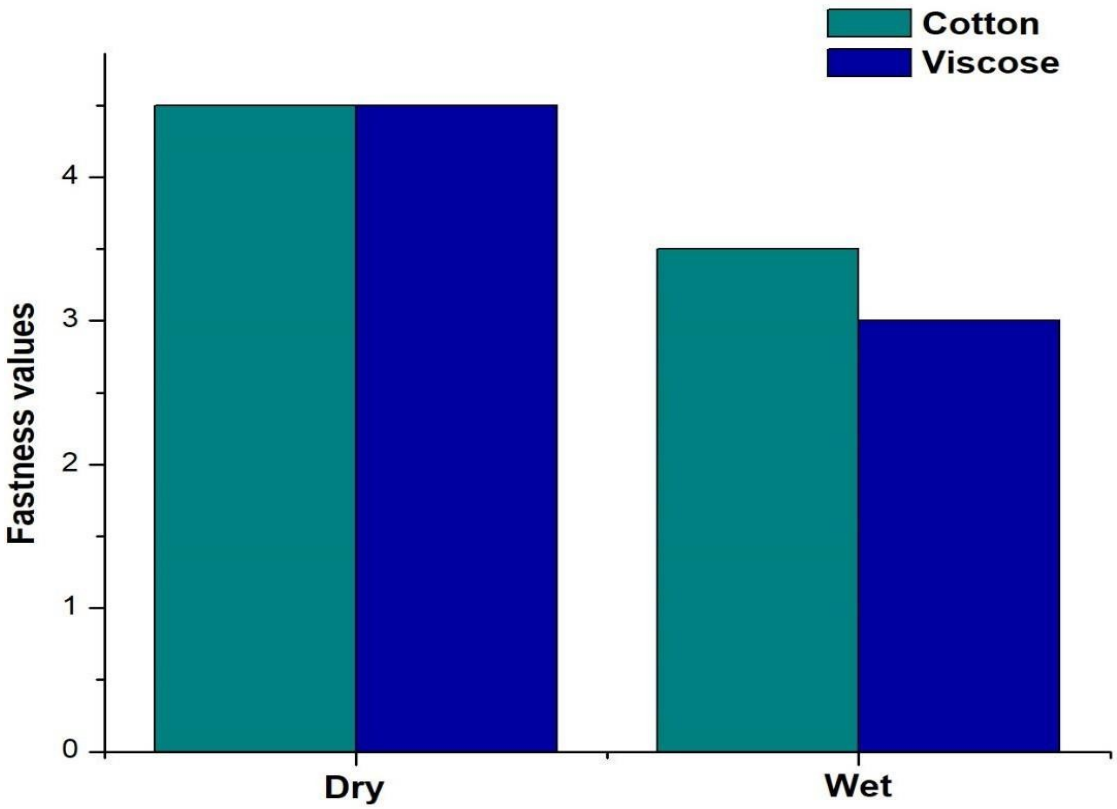


Figure 4.6: Color Fastness to Rubbing.

Very good (4-5) results are found for dry rubbing test which are better than wet rubbing samples for both fabrics.

4.7 Color Fastness to Perspiration:

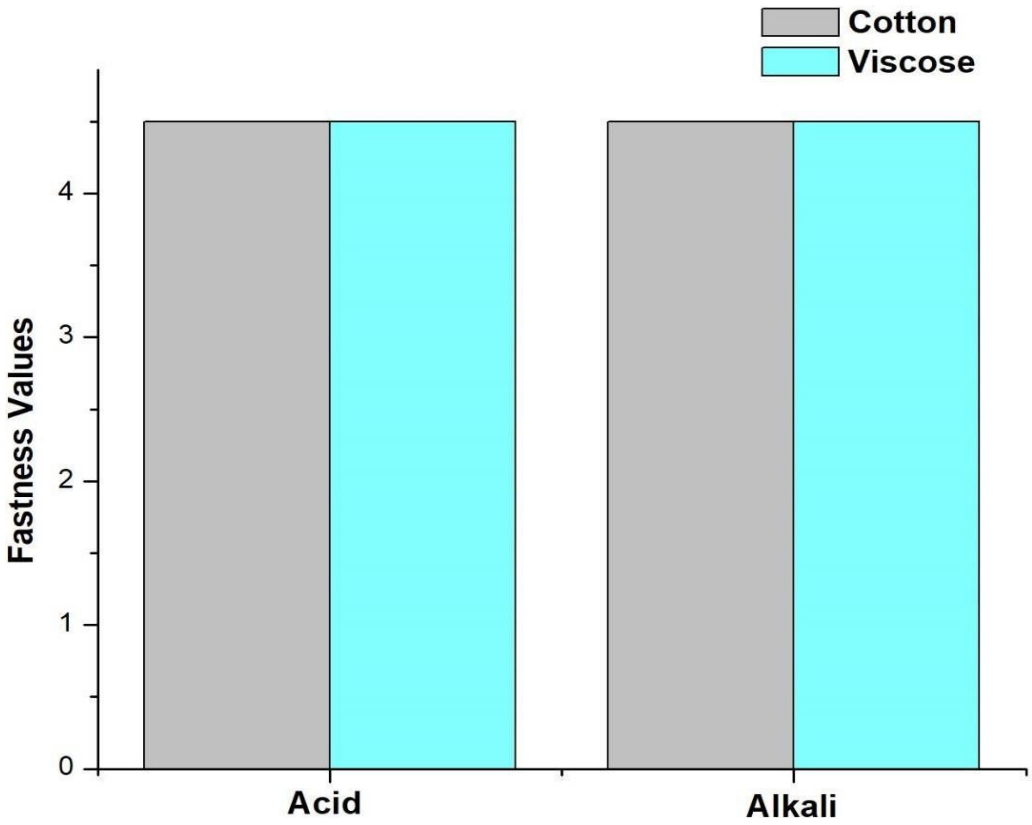


Figure 4.7: Color Fastness to Perspiration.

Both acid and alkali samples show very good (4-5) values for both cotton and viscose fabrics.

4.8 Color Fastness to light:

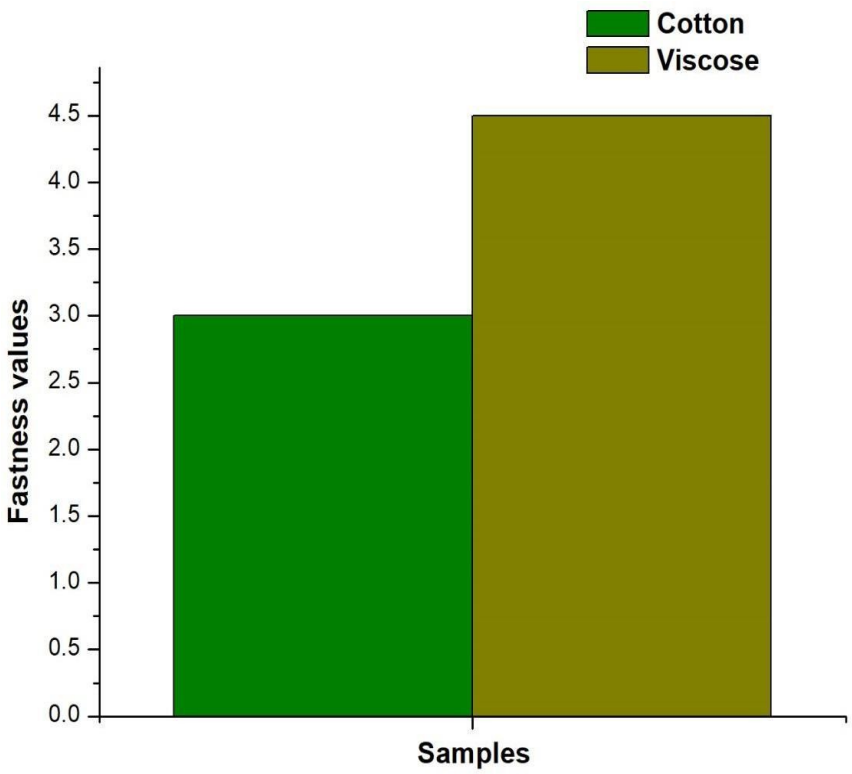


Figure 4.8: Coor Fastness to light.

According to figure, in case of cotton, color fastness to light depicts good (3), on the other hand, viscose represents very good (4-5).

4.9 Color Fastness to Water:

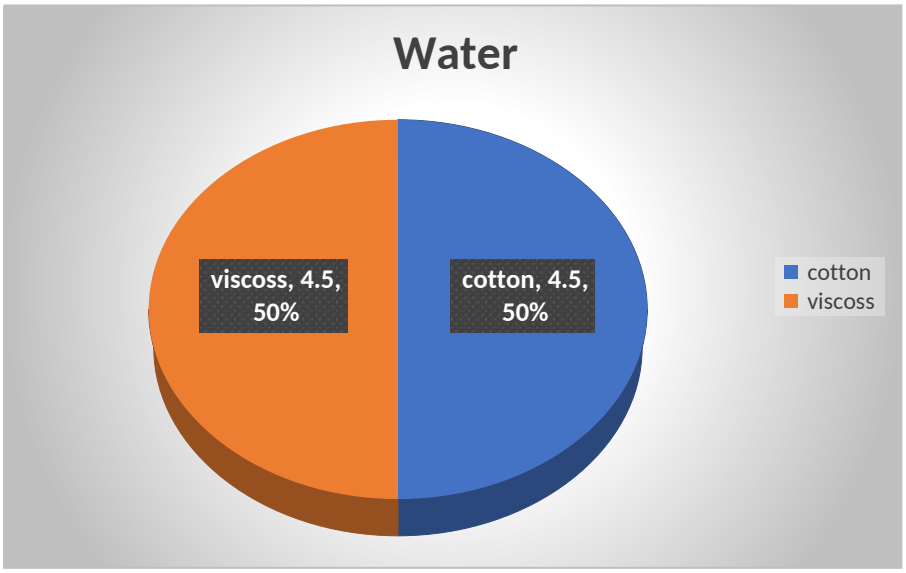


Figure 4.9: Fastness to water

Very good result on both cotton and viscose (4-5)

4.10 Color Fastness to saliva:

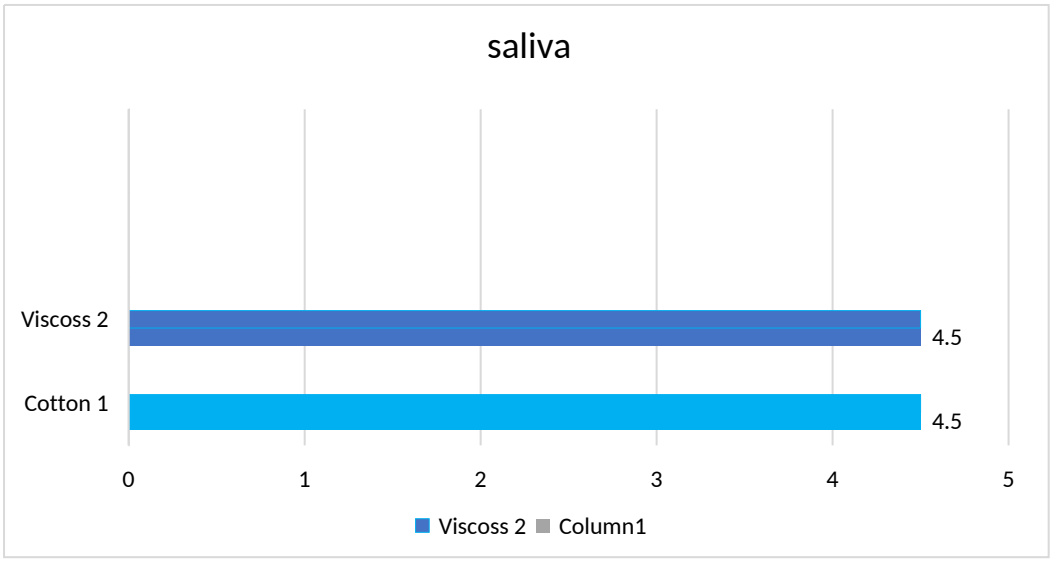


Figure 4.10: Color Fastness to saliva

Usually, this test plays a key role in ensuring that textiles will last and remain durable, especially for items made for use in the mouth or on children's garments. The produced cotton and viscose have a scale (4-5).

4.11 Pilling and Bursting:

Test	Cotton	Viscose
Pilling	4	3-4
Bursting	540 kPa	385 kPa

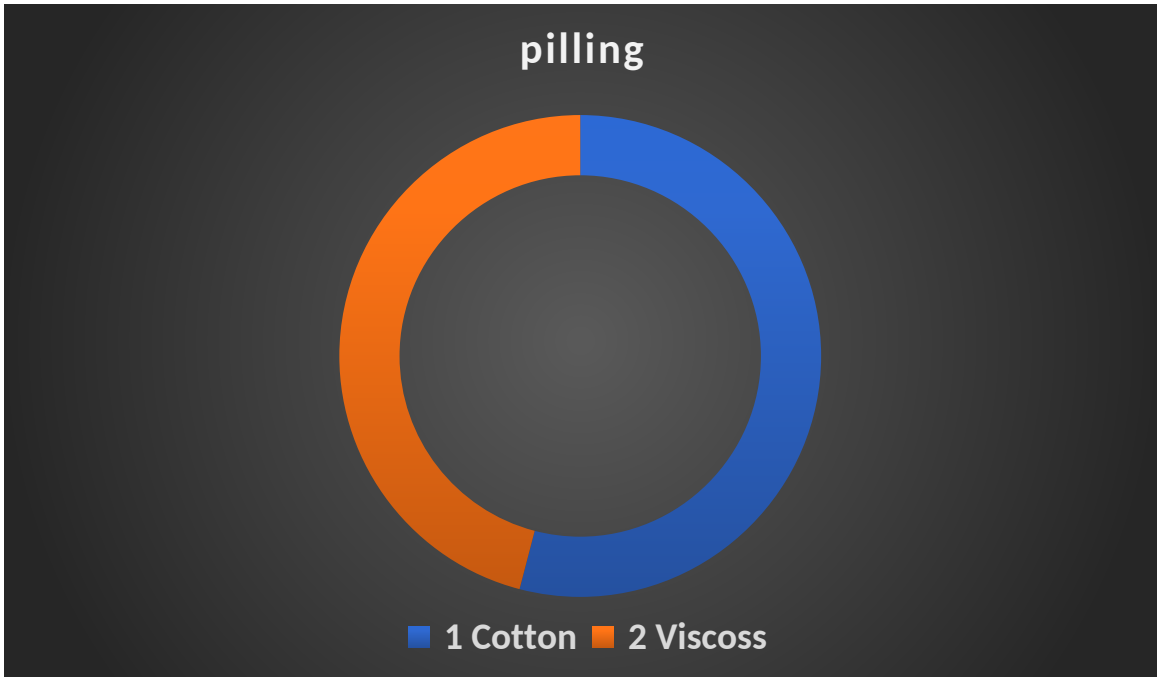


Figure 4.11: Pilling

Low pilling (4) is found for cotton fabric whereas moderately severe pilling (3-4) is observed for viscose fabric.

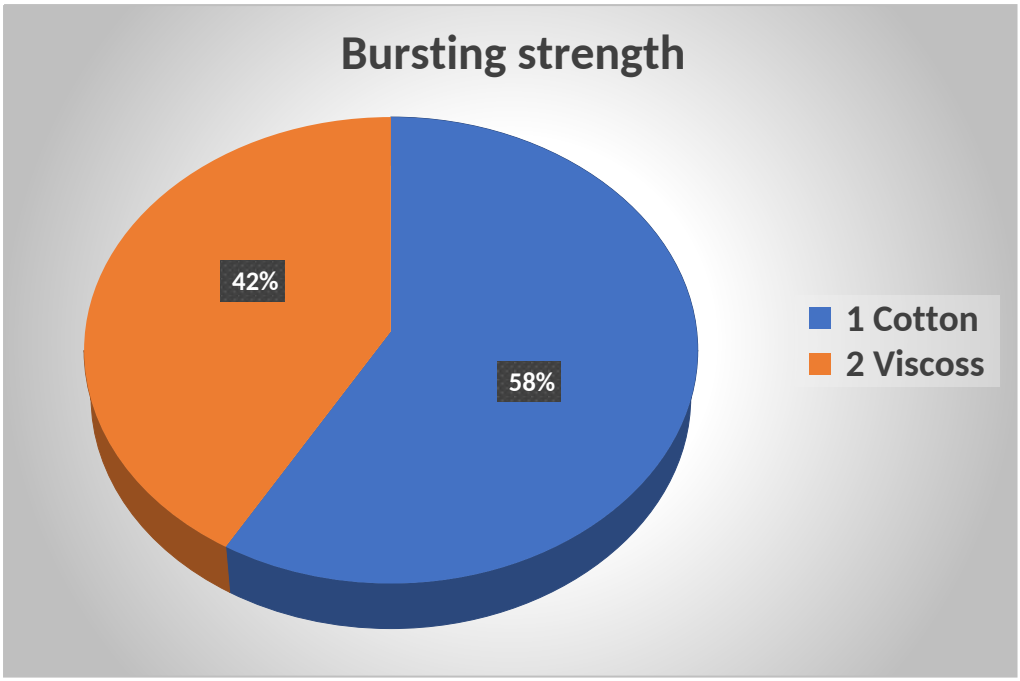
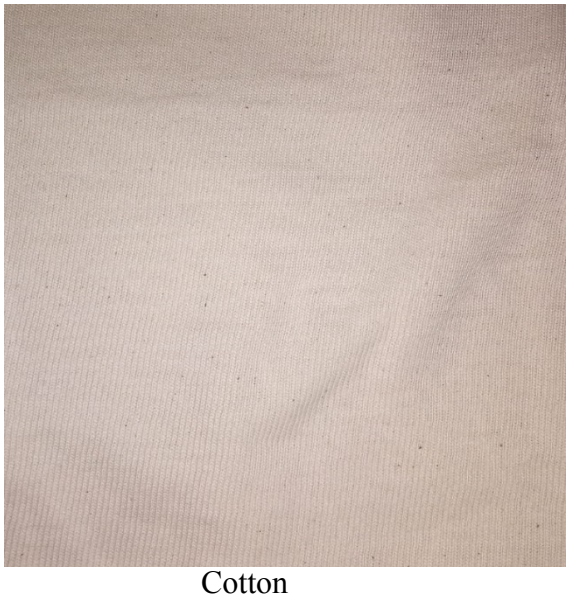


Figure 4.11: Bursting strength of fabrics

Bursting strength for cotton is 58% more than viscose which is more than double from the value of viscose fabric

4.12 Sample:

1.Before Dyeing:



Cotton

Viscose

2.After dyeing:

Cotton

Viscose

Chapter-Five

5. Conclusion:

The project demonstrates cotton fabrics achieve much higher bursting strength than viscose ones and pass the pilling test in higher numbers. Even though viscose has better speed to light, on all other criteria cotton showed abetter position than viscose. After dyeing, the reflectance of both types of samples is almost the same, with almost a doubling for cotton and not for viscose.

Using reactive dyes that react in different ways offers a solid answer to the problems of sustainable dyeing in cotton and viscose fabrics. Their impact on the planet is reduced as they improve the durability and quality of anything made from fabric.

Chapter-Six

6. Reference:

1. https://typeset.io/papers/jersey-fabric-garment-and-cover-formed-from-jersey-fabric-4yuhg19z67(2020)

2. https://typeset.io/papers/jersey-fabric-garment-and-cover-formed-from-jersey-fabric-4yuhg19z67 (2019)

3. https://typeset.io/papers/the-effects-of-fabric-type-fabric-width-and-model-type-on-1nklzf4q1f (2017)

4. https://typeset.io/papers/identification-of-single-and-double-jersey-fabrics-using-inqx9ca4p6 (2015)

5. https://typeset.io/papers/t-r-polyester-rayon-bulky-spandex-jersey-478unzq75t (2011)

6. https://typeset.io/papers/cotton-fiber-processing-device-2fqq529doq (2021)

7. https://typeset.io/papers/organic-cotton-fiber-bunchy-yarn-and-manufacturing-process-1azgcspyvw (2020)

8. https://typeset.io/papers/cotton-textile-production-process-4jkptwyxlc (2019)

9. https://typeset.io/papers/effect-of-reactive-dyes-structure-on-light-fastness-4j6jprdrvs (2014)

10. https://typeset.io/papers/reactive-dye-reactive-dye-composition-and-preparation-method-2mqb1dgcrv (2017)

11. https://typeset.io/papers/the-synthesis-and-application-of-reactive-dyes-based-on-44-4f3unywsh7 (2024)

12. https://typeset.io/papers/mechanism-of-bonding-reactive-dyes-with-copolymer-2glcbnf3 (2022)

13. https://typeset.io/papers/reactive-dye-and-its-advancements-il3k6on3 (2022)

14. https://typeset.io/papers/dyeing-process-of-reactive-dye-nl1kj50u34 (2018)

15. homed, N. S. E. (2005). The use of sodium date in the dyeing of cotton with reactive dyes. Dyes and Pigments, 65(3), 221-225.

16. Anderson, C. B. (1994). Dyeing reactive dyes using less salt. American Dyestuff Reporter, 83(9), 103-105.

17. Anon. (1996). Ciba introduces low-salt reactive dyeing. Textile Industries Digests Southern Africa, 15(5), 5-8.

18. Babu, B. R., Parade, A. K., Raghu, S., & Prem Kumar, T. (2007). Cotton textile processing: waste generation and effluent treatment. Journal of Cotton Science, 11(3), 141-153.

19. Bide, M. (2007a). Decolorization of effluent and re-use of spent dyebath. In R. M. Christie (Ed.), Environmental Aspects of Textile Dyeing (First ed., pp. 149-190): Woodhead Publishing Ltd.

20. Bide, M. (2007b). Environmentally responsible dye application. In R. M. Christie (Ed.), Environmental Aspects of Textile Dyeing (First ed., pp. 74-92): Woodhead Publishing Ltd.

21. Blackburn, R. S., & Burkinshaw, S. M. (2003). Treatment of cellulose with cationic, nucleophilic polymers to enable reactive dyeing at neutral pH without electrolyte addition. Journal of Applied Polymer Science, 89(4), 1026-1031

22. Physic-chemical Aspects of Textile Coloration by Stephen M. Burkinshaw

23. Textile Chemistry by Thomas Bechtold, Tung Pham

THANK YOU

0242310014123004 ORIGINALITY REPORT

7% SIMILARITY INDEX

6% INTERNET SOURCES

3% PUBLICATIONS

4% STUDENTPAPERS

[1] 2% dspace.daffodilvarsity.edu.bd:8080

Internet Source

[2] 1% www.researchgate.net

Internet Source

[3] 1% Submitted to Daffodil International University Student Paper

[4] 1% m.scirp.org

Internet Source

[5] <1% textilelearner.blogspot.com

Internet Source

[6] <1% promocodes.rappler.com

Internet Source

[7] <1% Submitted to Ahsanullah University of Science and Technology

Student Paper

[8] <1% jnasp.kinnaird.edu.pk

Internet Source

[9] <1% core.ac.uk

Internet Source

[10] <1% Submitted to SVKM International School

Student Paper

[11] <1% outlanderpastlives.com

Internet Source

[12] <1% Submitted to University of Southampton

Student Paper

[13] <1% article.sapub.org

Internet Source

[14] <1% etd.aau.edu.et

Internet Source

[15] <1% Submitted to The Scientific & Technological Research Council of Turkey (TUBITAK)

Student Paper

[16] <1% dokumen.pub

Internet Source

[17] <1% espace.rmc-cmr.ca

Internet Source

[18] <1% www.intechopen.com

Internet Source

[19] <1% Sawatwarakul, Weethima. "A Diagnostic Expert System for the Dyeing of Protein Fibers.", Proquest, 2015.

Publication

[20] <1% Stuart Rosenberg. "Deaf in the Family: The pursuit of a business venture with uncertain profit potential", The CASE Journal, 2009

Publication

[21] <1% the-oversized-hoodie.com

Internet Source

[22] <1% "Proceedings of the International Colloquium in Textile Engineering, Fashion, Apparel and Design 2014 (ICTEFAD 2014)", Springer Nature, 2014

Publication

[23] <1% "Textiles and Clothing", Wiley, 2019

Publication

[24] <1% Corry, M. Shivaun. "Civil Religion and the Second Amendment", Duquesne University,2021

Publication

[25] <1% Khanal, Lokendra Raj. "Advanced Magnetic Nanomaterials and Nanotechnology for Applications of Nuclear Radiation Detection and Ultrahigh Frequency Electronics.",

University of Idaho, 2020

Publication

[26] <1% Shaima Islam, Nasrin Akter, Md. Reazuddin Repon, Md. Abdullah Al Mamun. "Effect of natural thickener on printing performance over cotton woven fabric", Heliyon, 2024

Publication

[27] <1% agrifutures.com.au

Internet Source

[28] <1% etheses.whiterose.ac.uk

Internet Source

[29] <1% ir.bdu.edu.et

Internet Source

[30] <1% ndl.ethernet.edu.et

Internet Source

[31] <1% repository.lib.ncsu.edu

Internet Source

[32] <1% ujcontent.uj.ac.za

Internet Source

[33] <1% www.textileblog.com

Internet Source

[34] <1% Alfaro, Victor, Jr.. "Principal Retention: A Phenomenological Exploration of Principal Attrition and Strategies to Build Capacity and Sustainability in the Retention of School Leaders", Texas Christian University

Publication

[35] <1% Ashis Kumar Samanta, Tapas Ranjan Kar, Asis Mukhopadhyay, Debashis Shome, Adwaita Konar. "Eco-friendly salt-free reactive dyeing of cotton (muslin) fabric after cationization with amino acid from soya", Textile Research Journal, 2016

Publication

[36] <1% Ana M. Martínez-Alemán. "Accountability, Pragmatic Aims, and the American University", Routledge, 2019

Publication