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Studies on

Reuse of spent Dye Bath in Cotton and Viscose dyeing

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DECLARATION

We hereby declaring that, the research work of this thesis has been conducted by us under the supervision of **Mr. Tanvir Ahmed Chowdhury**, Assistant Professor, Department of Textile Engineering, Faculty of Engineering, Daffodil international University (DIU). The thesis titled,” Reusing the wastages of reactive dye to the cotton and viscose fiber”. All belongings of this report are authentic according to our knowledge. we also declare that, neither this thesis report nor any part of it has been submitted elsewhere for award of any degree.

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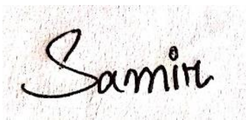

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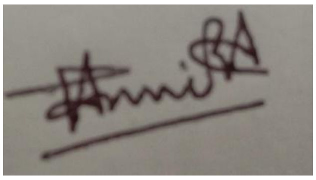
LETTER OF APPROVAL

Titled of the thesis “Reusing the wastages of reactive dyes in reactive and viscose fiber” is prepared by Md. Mohibulla and Samir Mondal Robi of bearing ID: 191-23-5580 and 191-23-5513. This thesis report is submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Textile Engineering. The whole report is prepared based on proper investigation and interpretation though critical analysis of data with required belongings.



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I would like to take this opportunity to thank all those people who helped me in this thesis and special thanks to **Md, Mehedi Hasan**, HR, Fakir Apparels Limited, giving me the opportunity of working in their laboratory. Finally, I like to thank all respected teachers of the Department of Textile Engineering, DIU for their insightful information, advice and suggestions.

This thesis

has been dedicated

to

my beloved parents

Abstract

The aim of this work was to find a suitable dyeing process so that expensive reactive dyes could be reused without dehydration. Bleached cotton, viscose fabrics were dyed with four different ways. It was found that the two-stage, two-bath reactive dyeing method, in which the discharge process and the fixing process are separated, is the most suitable for reusing the dye bath. Reusing reactive dyes after another bath process is especially suitable for higher color depths (4% and above). This process not only makes the best use of expensive reactive dyes, but also produces very little water pollution due to the low amount of dye in the wastewater. The process is therefore economical as well as environmentally friendly.

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Chapter One

Introduction:

1.1. Background of the Study:

Textile wastewater from dye factories, dyes, heavy metals, etc. is a major environmental problem. All high levels of salt are water contaminants. To reduce the concentration of these chemicals. When wastewater is discharged, the main effort lies in the removal of toxic substances from the wastewater. In recent years, the reuse of dye baths has attracted more and more attention. Not only does it reduce the toxicity of dye waste, it also saves dye, chemical and energy costs important. A dyebath is a complex system involving many variables that are not easily controlled for reuse, but excellent Batch-to-batch color consistency can be achieved. It has also been reported that it is possible to reuse multiple colors. However, in addition to the reuse of individual shades, finishes and other extractable impurities from the fibers can accumulate. Limit reuse cycles as these chemicals can interact with dyes and other dye baths
Additive. Reactive dyes are one of the most commonly used dyes due to their excellent wash fastness and comfortable to use. The affinity of reactive dyes for cellulose is not very high. Therefore, many salts (eg 50-100 g/l) are used to improve dye adsorption. However, the fixability of reactive dyes is not high 50-90% yield. In other words, up to 50% of the dye remains in the bath after dyeing. both are expensive.

Concentrations of salts and dyes left in the bathtub cause fouling. Indeed, reported

It is no exaggeration to say that "reactive dyes are a major problem in color cleaning".

In order to solve the problem of reactive dye bath recycling, dye bath recycling technology is incomplete.

1.2. Present State Problem:

The problems of research are given in the below-

In before researches, researcher has used other chemical to neutralize to acidity or basicity of the liquor, either it goes through the chemical treatment or other treatment to neutralize the spent liquor.

Or, it has been used in other different fibers like jute or silk. But it did not used to the cotton or viscose again directly or by doing slightly chemical change. This is the first where I used only cotton and viscose fiber directly in reusing of reactive dye spent bath and wash, rubbing fastnesses are tested.

1.3. Objectives with specific aims and outcomes:

The objectives and outcomes of the experiment are given in the below:

1. To reduce the water and environmental pollution
2. To decrease the pressure on E.T.P
3. To reduce the cost of E.T.P
4. To reduce dye and other chemical cost.
5. It will bring economical and environmental sustainability

Chapter Two

Literature Review

2.1. Introduction:

The textile dyeing process is generally carried out in a water-based dyebath, and the dyeing process requires the addition of dyestuffs and inorganic salts as dyeing accelerators or retarders, so textile dyeing uses a large amount of water and pollutes aqueous Generate a waste stream. A typical dye shop requires about 0.2-0.5 m3 of water to complete 1 kg of fabric. Dyeing effluents are known to have strong colors and high COD values, as more than 15% of textile dyes are typically lost in the effluent stream during the dyeing process. It is a well-known fact that over 50% of cotton products are dyed with reactive dyes, making reactive dyes one of the leading classes of colorants for dyeing cellulose fibers. Furthermore, dyeing cellulose fibers with reactive dyes usually requires a large amount of salt, which is a source of contamination of the dye waste. Additionally, wastewater containing reactive dyes is often stubborn and resistant to microbial degradation. Dumping these waters directly to the environment occurring deterioration to the lives. Impurities reduces DO to the water, higher slats, basic conditions caused death of fish, algae, other living organisms into the water, which are directly related to the human livings, food chain and diversities. Using these inorganic slats and chemicals will be directly release to the environment after dyeing process. A small number of toxics will may remove in ETP by sludge production. But will not be removed and Processes are very time consumed and costly.

In recent years, rising costs of water and wastewater treatment and stricter government regulations on wastewater discharge have forced textile processors to reuse treated water. A better alternative is to treat dye factory wastewater for reuse.

So, there I did an experiment on the based on using the after dyeing wastages in in the new fiber. It reduces the salt, base like, sodium hydroxide or bi-carbonates from the water, reduced a large amount of fresh water consumption as we dyeing by using waste water. After dyeing, very less amount of chemicals will remain in the bath and treatment of these chemicals will be very easier and less timely. That will reduce a large amount of environmental pollution by textile industry

2.2. Reactive blue-19

Molecular Formula: $C_{22}H_{16}N_2Na_2O_{11}S_3$

Molecular Weight: 626.55

2.2.1 Properties and Applications:

Light blue. A blue powder that is a strong solution of sulfuric acid for a red sauce after dilute ocean sedimentation. In nitric acid it is yellow, diluted yellow. The aqueous solution is blue, unchanged in Moore's Caustic Sodalite 1 and continues to add to the insurance powder, with a warm reddish-brown precipitate. Add sodium borate for a light purple color. 20°C with a solubility of 150 g/L or more. After colorfully dyeing the hue blue, iron ions and copper ions hit Colored Light Basic Uncorrected (Level 5). Affine high for dyes, high for response, and two levels of white for 1/1 depth of standard. Used for cotton, viscose fiber spreading, roll dyeing, overlap knot dyeing and continuous pad dyeing.

2.3. Fabric

Single jersey, also called base fabric, is a knitted fabric. Knitted with a single row needle. This fabric has a flat loop on one side and a reverse loop on the other side, so the front and back are different. This fabric is produced in tube form on a circular knitting machine, but can also be cut and used in open widths. Larger widths can be purchased for single jersey fabric. This widely used fabric is generally soft, stretchy, and easy to wear. It's easy to iron and doesn't wrinkle easily. The wide weight range of this fabric allows it to be used in all-season garments. Recommended mainly for T-shirts, dresses, underwear, leggings, home wear, sportswear, and bedding.

GSM (Gram / Sq. meter): 160

Material/Composition: 100% Cotton,

Fabric type: White

Knitting type: Warp knitting

2.4. Levelling agents:

Leveling agents are surfactants, so they can be anionic, cationic, nonionic, or amphoteric. The main mechanism of non-ionicity is to form water-soluble complexes with dyes. He can distinguish two main groups of ionic drugs. They are either dye substances (products with an affinity for dyes) or textile substances (products with an affinity for fibers). In the case of color fastness leveling agents, there is a competition for the dye between the leveling agent and the fiber. Fiber-friendly products compete with the dye for its position on the fiber. The attraction between the drug and the dye creates a counterbalance to the attraction of the dye fiber, thereby inhibiting dye uptake by the fiber. As the temperature rises, the complex gradually decomposes, releasing the dye for even absorption through the fibers.

The colorant complex varies with the nature of the dye, the nature of the substrate, and the nature of the leveling agent. Therefore, different dyeing processes require different leveling agents. The textile substantive leveling agent should be of the same ionicity as the dye. That is, anionic agents are used with anionic dyes and cationic agents are used with cationic dyes. When choosing a suitable leveling agent, make sure the ionic charge is not too weak. Otherwise, it will not act as an effective leveling agent. Second, if the ionic charge is too strong, it can exert a blocking effect and prevent dye sorption. Therefore, an ideal leveling agent should adsorb to the fiber more quickly than the dye, but the bond between the agent and the fiber should be weak enough to allow displacement by the dye ions.

2.4.1 Leveling for Cellulosic dyeing:

When exhaust dyeing cellulose, pad or continuous dyes using direct dyes, vat dyes, sulfur dyes, naphthol dyes, reactive dyes, indigo types, deactivating ions or the destructive effects of early oxidation dyes should be avoided.

Matlevel DLR fluids are designed to meet the need for uniform dyeing of fabrics with an effective combination of dispersibility and leveling properties. This allows dyers to simplify their processes and reduce dyeing times

i) Proper handling and introduction of the entire electrolyte before the dye;

ii) Linear addition of alkali for up to 30 minutes at the selected temperature without a dosing system.

2.5. Salt:

The fabric substrate and dye molecules do not necessarily have to have uniform properties in order to bond with each other. In such a scenario, a catalyst is required to enhance the dye effect on the fabric. Salt plays this important role as a catalyst. Salt has a very high affinity for water. Broadly speaking, in the dyeing process of textiles, salt he needs in three ways. The first is to press the dye into the fabric. Second, the use of salt causes a complete depletion of dye molecules in the fabric during the dyeing process. Thirdly, it serves to transfer, adsorb and fix the dye to the cellulosic material as an electrolyte. Salts play an important role in reactive dyeing by improving the affinity of dyes to fibers, promoting dye interactions and reducing their solubility. For this, Glauber's salt or table salt/evaporated salt is usually used. Equipment corrosion can be caused by chloride ions in table salt. Therefore, Glauber's salt is always preferable to table salt. The common name for sodium sulfate decahydrate, Na 2 SO 4 .10H 2 O, is Glauber's salt. It appears as monoclinic white or colorless crystals. It flowers when exposed to moderately dry air, forming powdery anhydrous sodium sulphate. The salt was first developed by Johann his Glauber (from Hungarian spring water). Glauber's salt is water-soluble, has a salty and bitter taste, and is often used medicinally as a mild laxative. It is also often used for coloring. The common name for sodium chloride (NaCl) is evaporated salt [12,18,19]. The Role of Salts in Reactive Dyeing Inorganic salts play two important roles in exhaust dyeing with reactive dyes-

- Increased dye affinity.
- Facilitate dye interactions and reduce their solubility.

In general, reactive dyes contain groups of sulfonic acids (-SO3H) that are insoluble in water. During the production of reactive dyes, these sulfonic acid groups are converted to the water-soluble sodium salt of sulfonic acid (-SO3 Na) [19-22] (Fig. 1). Reactive Dye – SO3 H + Na+ → Reactive Dye SO3 Na Generally, when a reactive dye enters the bath, it is solubilized, producing dye anions and sodium cations. Reactive Dye - SO3 Na + Water -- → Reactive Dye - SO3 - + Na+ (dye anion) (sodium cation) Function of Salt in the Dyeing

2.5.1 Process:

• In reactive dyeing, the salt increases the dye's affinity for the cellulose substrate.

• Salt increases the rate of discharge of reactive dyes.

• Reactive dyes have a lower affinity, so more inorganic salts are needed to facilitate absorption when using reactive dyes.

The amount of inorganic salt used depends on the form of the dye used, but recently prepared high-fixing and high-affinity dyes can reduce the amount of inorganic salt. Both Glauber's salt and table salt (sodium chloride) are used for staining due to their effectiveness and cost. These two are essentially identical with respect to their position as inorganic salts due to the active sodium cation in both [19,21,22]. Reactive dyes are water-soluble dyes. At neutral pH in the presence of Glauber's salts, these water-soluble dyes are attracted to cellulose fibers. Fixation takes place under alkaline conditions, during which covalent bonds are formed between fiber reactive sites and cellulose inclusions. Alkali is necessary during the fixing stage as it acts as a catalyst between the dye and the fibre. The decisive factor is not the form or amount of alkali,

but the pH value of the bath. Various alkalis such as calcined soda, caustic soda and sodium phosphate are used to fix reactive dyeing. This alkali puts a strain on the wastewater treatment plant, so especially the alkalizing agent applied during dyeing changes the pH of the bath and helps to obtain uniform dyeing. load is reduced [20]. The effect of salt depends on the ratio of salt in the solution. The influence of salt in the cotton dyeing process is of great importance. Accurate and desired tones of objects cannot be achieved without salt. Therefore, the value of salt in dyeing is immeasurable. Some of the electrolytes used for dyeing.
Glauber's salt (Na2 SO4 10 H2 O) Sodium chloride (NaCl) Zinc sulfate (ZnSO4) Aluminum sulfate [Al2 (SO4)3] Ammonium chloride (NH4 Cl).

2.6. Sodium Bi- Carbonate:

IUPAC name: sodium hydrogen carbonate.

Formula: NaHCO3

Sodium bicarbonate, commonly known as baking soda or baking soda, is a chemical compound. It is a salt composed of sodium cation (Na+) and bicarbonate anion (HCO3-). Sodium bicarbonate is a crystalline white solid that often looks like a fine powder. It has a slightly salty, alkaline taste similar to soda carbonate (sodium carbonate). The natural mineral form is Narcolite. It is a component of sodium bicarbonate and is dissolved in many mineral springs. From chemical industry to domestic use, sodium bicarbonate is used in a wide range of applications. In addition, this substance is widely used in the production of medicines. One of the many benefits of sodium bicarbonate is that it kills most bacteria and fungi and acts as a disinfectant, making it an important ingredient in many pharmaceuticals and cleaning agents. Sodium bicarbonate is an amphoteric compound. am. Aqueous solutions are slightly alkaline due to the formation of carbonate and hydroxide ions. ($HCO_3^- + H_2O \rightarrow H_2CO_3 + OH^-$). Sodium bicarbonate is used in curing wool and silk fiber. It also aids in the dyeing and printing of wool and silk fabrics.

Molar Mass	:84.0066 g/mol
Density	:2.159 g/cm3
Odor	: Odorless
Melting Point	:270°C (decomp)
Solubility in Water	:7.8 g/100 mL (18°C) and 10 g/100 mL (20°C)
Solubility	: Insoluble in Alcohol
Acidity	:10.3

Refractive Index :1.500

2.6.1 Sodium Perborate tetrahydrate

Appearance	White, free-flowing granule
Available Oxygen, %	≥15.1
pH value	9.9~10.9
Iron (ii, iii), %	≤0.0015
Bulk Density, g/L	500-640
Wet Stability, %	≥82

Table 1.2.6.1 Sodium Perborate tetrahydrate

Sodium perborate is converted to water, oxygen and hydrogen peroxide by catalase. Its antibacterial properties result from perturbation of cell membrane oxidation, membrane-bound enzymes, and protein synthesis. Sodium perborate is an active oxygen used for whitening, bleaching, cleansing and deodorizing. Sodium perborate can be used in a variety of cleaning products such as: B. Detergents, automatic dishwashing detergents, oxygen bleach powders, fabric softeners, hand dishwashing detergents, all-purpose cleaners, air fresheners, stain removers. Products like Oxi-Clean consist almost entirely of this material. Widely used as an oxidizing agent for in-dancillin dyes, bleaching and degreasing agents for raw fabrics, disinfecting and sterilizing agents for pharmaceuticals, mordants, cleaning aids, deodorants, additives for electroplating solutions, analytical reagents, organic polymerization agents, etc. It has been. toothpaste, cosmetics, etc.

2.7. ECE Detergent:

This phosphate-free washing powder is a perfectly homogeneous product, ensuring excellent batch-to-batch continuity and promoting excellent shelf life. Products are spray-dried to ensure there is no risk of breaking down into component parts, eliminating the possibility of inconsistent results. There are different types of his ECE cleaners such as SDCE ECE (B) Phosphate (SDCE Type 3). This product has been manufactured for use in the ISO 105 C series of color fastness tests. This product was manufactured for use with IEC 456.

The powder does not contain optical brighteners and the formulation is strictly controlled to meet ISO standard specifications. This phosphate-free washing powder is a perfectly homogeneous product, ensuring excellent batch-to-batch continuity and promoting excellent shelf life. Products are spray dried to ensure there is no risk of breaking down into component parts, eliminating the possibility of inconsistent results.

Machines and Equipment’s

2.8. ATAC sample dyeing machine:

Infrared heat dyeing machine for dyeing small samples of textile materials. Suitable for high temperature and normal pressure dyeing methods. Capacities are available in 200cc or 300cc in 10, 16 or 24 cups / 500cc or 1200cc in 4, 8 or 12 cup increments.

Figure 1.2.8. ATAC sample dyeing machine

2.9. Spectrophotometer:

A spectrophotometer is a device that accurately measures electromagnetic energy at specific wavelengths of light. It distinguishes between hues and uses properties of light and energy to calculate the amount of each color in a ray.

Figure 2.2.9. Spectrophotometer

2.10. Rubbing fastness tester (crock master):

Rotary Color Fastness Tester (Rotary Color Fastness Tester) for printed fabrics, printing and dyeing industries, especially for detecting the color fastness of printed fabrics to dry or wet rubbing. A rotary color fastness tester is the most commonly used tester in the textile industry to test the color fastness of fabrics, especially printed fabrics, to dry or wet rubbing. A 16mm diameter friction head can deliver 1143 grams of pressure. The friction head first rubs clockwise for 1.125 cycles, then counterclockwise. The operating handle rotates in one direction only.

1. Reamer head diameter:16mm;
2. Pressure:1134g;
3. 1.125 cycles rotating first clockwise then counterclockwise.
4. Equipped with equipment for standard friction cloth.
5. The sample holder springs are made of steel, allowing quick sample loading and reproducible test results.
6. The device being designated AATCC

Figure 3.2.10. Rubbing fastness tester (crock master)

2.11. Auto chemical dispensing machine:

Automatic chemical dispensers are used to supply liquid chemicals to textile machines, etc. Chemicals are dosed fully automatically, depending on the machine controls used. In other words, the machine control requests the required chemicals, the chemical dispenser supplies them, and makes sure the correct amount is sent to the requested tank.

Figure 4.2.11. Auto chemical dispensing machine

2.12. Light Box:

For visual assessment, use a standardized fabric light box or fabric light box to maintain consistency in light source, viewing area, and presentation of specimens. All shade evaluation and color matching should be done in a dedicated color matching cabinet called a fabric light box or textile light box. This cabinet is available in a variety of sizes from multiple manufacturers.

Figure 5.2.12. Light box

2.13. Grey scale:

A "grayscale" version of an image uses a mixture of black and white to represent color "values". The gray scale is used to visually assess the color change of textiles through color fastness testing. There are two types of grayscale. One to assess color change and one to assess discoloration.

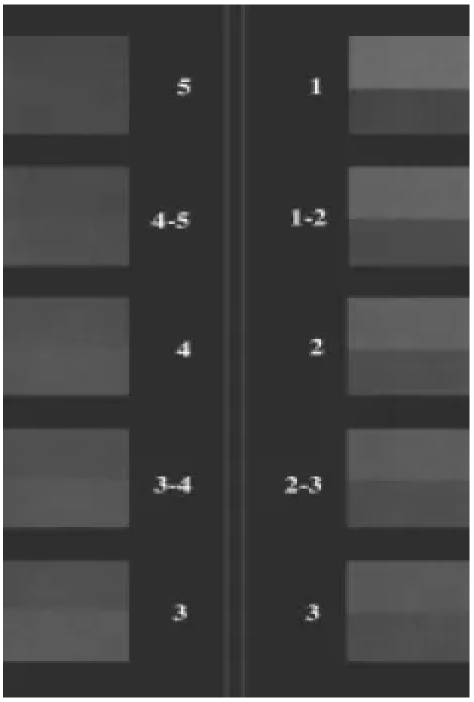


Figure 6.2. 13. Grey scale

2.14. Weight balance:

A scale or balance is a device used to measure weight or mass. These are also known as mass scales, weight scales, mass balances, and weight balances.

Figure 7.2.14. weight balance

2.15. Multifiber:

Multifiber is used as the adjacent fabric in many color fastness tests, to assess the color transfer of materials. These tests are typically those such as:

- Color fastness to washing
- Dry cleaning
- Water
- Perspiration, and many others.

The Dye Fastness Test determines the resistance of a substance to changes in its color properties and to the transfer of color to adjacent substances and materials.

Multifiber is one of the most common types of border fabrics, made from yarns of different types of common fibers, each forming strips of at least 15mm wide, giving the fabric a uniform thickness. Offers. James Heal manufactures the main types of multifiber in-house.

Multifiber DW and Multifiber LW. Fabric composition meets ISO 105 F10 requirements and is endorsed by Marks and Spencer, Next and many other British and European designers. Multifiber DW complies with ISO 105-F10. It consists of individual strips of the following components:

- Diacetate
- Bleached Cotton
- Polyamide
- Polyester
- Acrylic
- Wool

Figure 8.2.15. Multifiber

2.15.1. Common standards and test methods:

The most common standard is ISO 105-F09, which has two standardized multifiber sub fabrics-

- Type DW (Diacetate Wool): Cellulose diacetate, bleached cotton, polyamide, polyester, acrylic, wool

- Type TV (triacetate viscose): Contains cellulose triacetate, bleached cotton, polyamide, polyester, acrylic and viscose

"When using multifilament composite fabrics, there should be no other adjacent fabrics, as this may affect the stain level of multifilament fabrics. Use multifilament adjacent fabrics should be of the same dimensions as the sample to be tested (usually 40mm √ 100mm) and as a general rule should cover the front of the sample." Peter Gatwin

2.15.2. How to determine test results with multifiber:

Color fastness test results are determined by visual comparison under specified lighting and viewing conditions. Here, we assess the difference in color (or contrast) between untreated/unstained and treated/stained samples. Differences are displayed in grayscale to assess color change.

Chapter Three

Experiment Details

3.1. Materials:

Single jersey scoured-bleached 100% cotton, 100% cotton viscose single jersey scoured-bleached, reactive blue-19, levelling agent, salt, sodium bi-carbonate, sodium hydroxide, sodium perborate tetrahydrate, ECE detergent taken from the laboratory.

3.2. Machines and Equipment's:

ATAC sample dyeing machine, spectrophotometer, ATAC sample drying and sample hydro-extractor, iron, Zyro wash, rubbing fastness tester (Crock master), auto chemical dispensing machine, light box, grey scale, multifiber, steel ball, weight balance, scissor etc, available in the laboratory.

3.3. Essential parameters and calculations:

Here, total 8 sample has been taken, 6 of cotton and other 2 are viscose, 4 has been dyed with reactive blue-19 and produced 3% shade, other has been dyed with the wastage water. Here, every sample number is given cotton 1-6 and viscose 1,2. First 4 dyed, then number 5 and viscose 1 dyed with only wastages. Number 2 and 6 dyed with changing some chemical ratios.

3.3.1. Dyeing parameters:

Fabrication	: 100% cotton single jersey, 100% cotton viscose single jersey
Weight	: 10 gm
Dye	: Reactive blue-19, 3% shade
M: L	: 1:8, 1:6
Time	: 60 min
Temperature	: 60º C
pH	: over 11

3.4. Calculation:

As per the chemical schedule of laboratory:

For 3% shade,

Salt - 40 gpl

Soda - 10 gpl

Leveling - 2 gpl

3.4.1. Chemical taken from the auto dispenser:

Product code:	Conc. Req	Conc. in m/c	Weight
1021(Dye)	3%	2%	15 ml
3001(leveling)	2 gpl	8%	2 ml
3002 (Salt)	40 gpl	20%	16 ml
3005(Soda)	10 gpl	10%	8ml
			Total = 41 ml

Though, all calculation and chemical done by the auto dispenser machine. But also, I am giving below here-

Here, M: L = 1:8, means water needed for 1 gm sample is 8 ml.

So, for 10 gm sample water needed = 10×8

=80 ml

Total liquor for dyeing 10gm of sample will be 80 ml.

Dye = $\frac{Material\ weight \times Shade\ paercentage}{Stock\ solution\ percentage}$

$= \frac{10 \times 3\%}{2\%} =$ 15 ml

Leveling agent = $\frac{gpl \times Total\ liquor}{1000 \times Stock\ solution\ percentage}$

$= \frac{2 \times 80}{1000 \times \frac{8}{100}}$ =2 ml

Salt = $\frac{gpl \times Total\ liquor}{1000 \times Stock\ solution\ percentage}$

$= \frac{40 \times 80}{1000 \times 0.2}$ = 16 ml

Soda = $\frac{gpl \times Total\ liquor}{1000 \times Stock\ solution\ percentage}$

$= \frac{10 \times 80}{1000 \times 0.1} = 8$ ml

Water = $\{80 - (15 + 2 + 16 + 8)\}$

= 39 ml

Procedure

3.5. Dyeing:

Reactive dyes are very familiar for cotton dyeing. To start dyeing procedure, first 8 sample are taken, each 10gm cut by scissor and weight measured by the weight balancing machine. Sample dyeing bottles taken and shade percentage, all chemicals percentage given input to the computer. Then the recipe calculated automatically and poured into the bottle. Then 4 sample of cotton (1-4) fabric put into the bottle and set into the machine. Set the temperature 60ºC for one hour.

After 60 minutes of dyeing sample fabric taken. But here the most important part is in the bottle, wastages water. Then I put 1 cotton (no-5) sample and 1 viscose (no-1) sample in two pot. In other two some chemicals added. Here, I had to measure the M: L ratio, found 1:6 and calculate the soda, salt percentage for it. And put half of it. Then other two cotton-6 and viscose-2 sample put into the bath. Then start dyeing again for 60 minutes in 60ºC.

After Completing dyeing process, fabrics are washed by sopping chemicals, at 45ºC for 20 mins. Then put it into the sample hydro extracting and sample drier. After drying, Ironing takes place, then compared samples in Spectro photometer. Here, I checked tin these categories-

1. Only wastage dyeing cotton vs chemical added dyeing cotton
2. Only wastage dyeing viscose vs chemical added viscose
3. Only wastage dyeing cotton vs only wastage dyeing cotton

After comparing, all data taken and placed it for the next experiment wash and rubbing fastness test of wastage dyeing.

3.6. Fastness

3.6.1. Wash fastness:

Fastness is the resistance of a material to the destructive factor. To measure the fastness of a material sequential order should be maintained. First here, we cut our sample 10× 4 cm size with the multifiber. Then stitched it with the multifiber.

In another jug, here 1-liter fresh water taken and also taken-

1. 1 gm sodium perborate tetrahydrate
2. 4 gm ECE detergent

Then took a sample washing bottle, here take 150 ml solution from the jug, also put 10 steel balls in each pot, as I had 4 bottles, I took 40. Then clasp the lid of the bottle and put it into the machine for 30 minutes, at 40ºC.

After 40 minutes we tool the fabric, washed it and dried with the help of dryer, check shades with the help of grey scale in lightbox.

3.6.2. Rubbing fastness:

For testing rubbing fastness of a sample we need a rubbing fastness tester named **Cork-master** Here are few steps given in the below I did the experiments-

1. Set sample into the machine
2. Wear rubbing fabric into the machine nozzle
3. Set 10 cycle for each test
4. Turn on the machine and wait after the cycles finished

There dry rub explained. Wet rub is similar to that, but two drops of water given in the rub fabric before start rubbing test. After completing cycles square rub fabric took from the machine and check with the grey scale color destroyed or removed by rubbing.

Figure:3% shade

Figure: Wastage shade

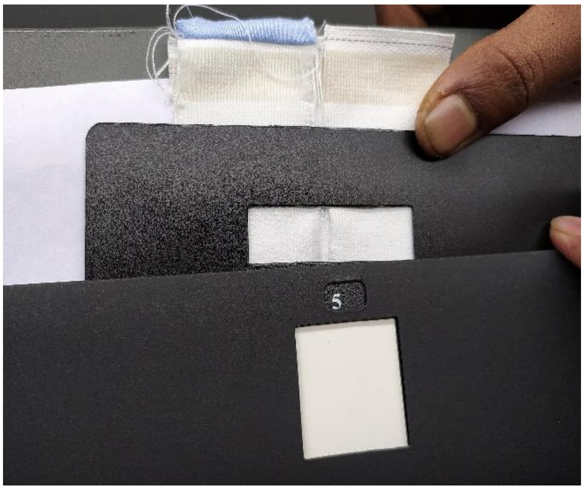


Figure: Color stain test

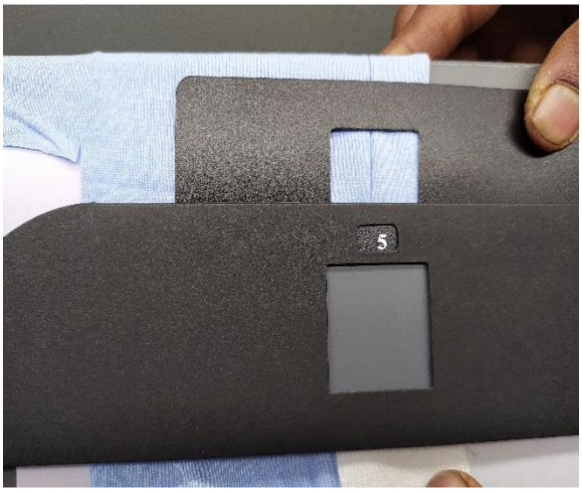


Figure: Color fastness test

Chapter Four

Result and Discussion

4.1. Material Specification:

Fabrication : 100% cotton single jersey, 100% cotton viscose single jersey

Weight : 10 gm

Dye : Reactive blue-19, 3% shade

Machine : ATAC sample dyeing machine.

Experiment Date : 11-12 January,2023

M: L : 1:8, 1:6

There 6 sample of 10gram, 100% cotton single jersey taken and 2 of 100% cotton viscose.

Then first 4 of 100% cotton dyed uniformly with the reactive blue of 3% shade.

After, dyeing the shade found is 0.1114%. which is very light. Most of the fixation done in the first dyeing. Now the comparisons there will be done between adding some extra chemicals, like salt, soda levelling and other is adding no chemicals, only using the wastages.

The color shade found by the wastage dyeing are given in the **Table -01**

2. 4.1.1. Table -01

Standard		Sky-2
Quality Style		100% cotton s/j
Substrate (factor)		100% cotton s/j- new (1.00)
Process (factor)		(1.00)
Formula		Cie lab Default[D65] Optimization dE first illuminant dH first illuminant
dE*D365	1.0	0.86
dL*D65		-0.73
da*D65		-0.45
db*D65		-0.08
dC*D65		0.17
dH*D65		-0.42
dE*F11	0.0	0.83
dL*F11		-0.81
da*F11		-0.17
db*F11		-0.09
dC*F11		0.12
dH*F11		-0.15

Metamerism F11	0.7	0.29
Metamerism A	0.5	0.34
Price	0.0	0.00
Total concentration [%]		0.1114
Trial 1		**
Dyestuff		1((1)
Reactive Blue 19		0.1114

Comparison of two cotton samples are in given the below on table no-02. There two samples of cotton, one of those is without chemicals and other one added with fewer chemicals.

3.4.1.2. Table-02

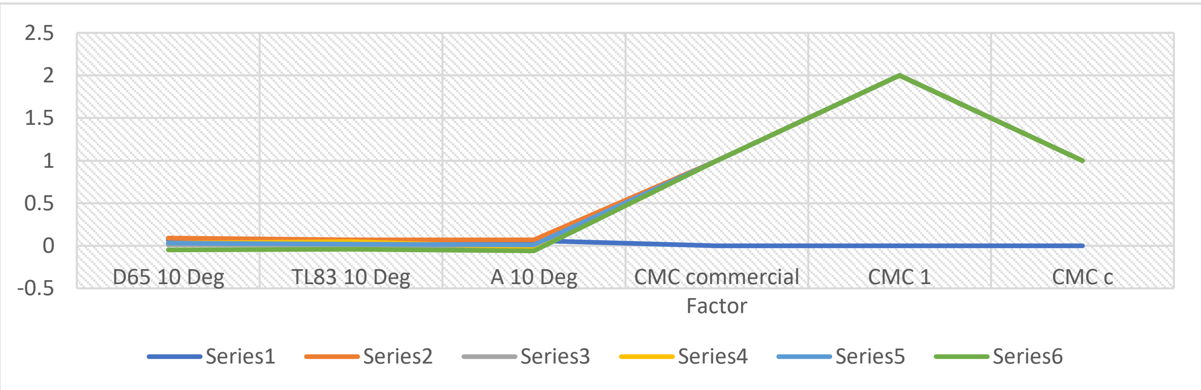
No of Sample	Extra Chemical	CMC DE	Batch comments	Metamerism Index
1. Cotton 2. Cotton	Only wastages Half chemicals used by calculating M: L	0.07	Lighter Less saturated Greener	D 65 vs TL83 0.03

Here, table no 2.1 is for more details-

4.4.1.2.1 Table

Illuminants	CMC DE*	DL*	Da*	Db*	DC*	DH*
D65 10 Deg	0.07	0.02	-0.08	0.02	-0.00	-0.08
TL83 10 Deg	0.05	0.02	-0.06	0.04	-0.03	-0.06
A 10 Deg	0.06	0.01	-0.08	-0.01	0.03	-0.07
CMC commercial Factor						1.00
CMC 1						2.00
CMC c						1.00

In the graph it could be shown like below-



Comparison of two viscose samples are in given the below on table no-02. There two samples of viscose, one of those is without chemicals and other added with fewer chemicals.

5.4.1.3. Table-03

No of Sample	Extra Chemical	CMC DE	Batch comments	Metamerism Index
1.Viscose	Only wastages	0.46	Darker More saturated Redder	D 65 vs TL83 0.12
2.Viscose	Half chemicals used by calculating M: L			

6.4.1.3.1. Table

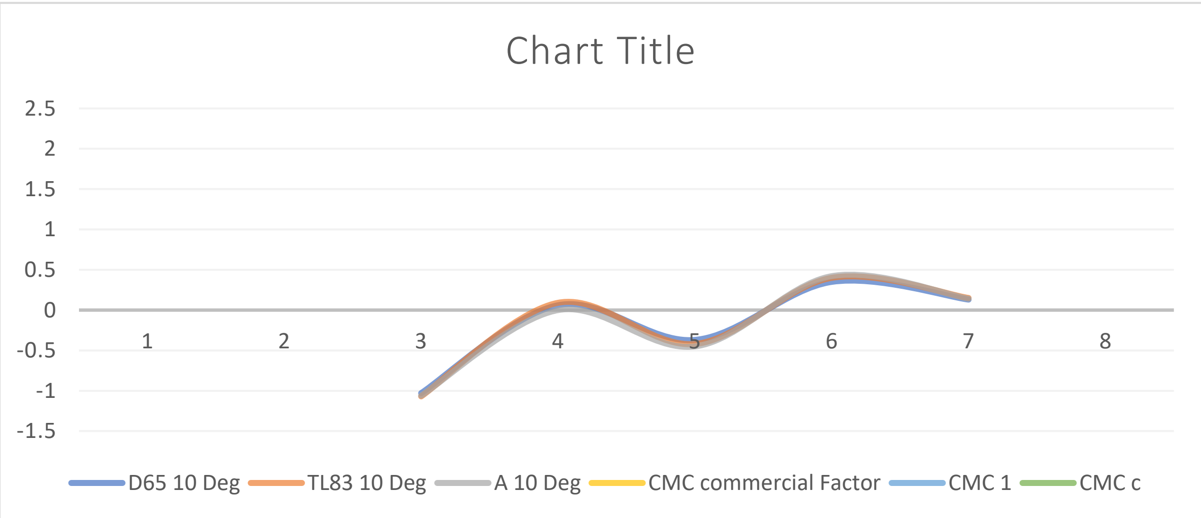
Here, table no 3.1 is for more details-

Illuminants	CMC DE*	DL*	Da*	Db*	DC*	DH*
D65 10 Deg	0.46	-1.03	0.06	-0.37	0.35	0.13
TL83 10 Deg	0.48	-1.07	0.09	-0.42	0.40	0.15
A 10 Deg	0.48	-1.06	0.00	-0.45	0.42	0.14
CMC commercial Factor		1.00				
CMC 1		2.00				
CMC c		1.00				

These data table shows that adding chemicals given no value to the new sample. There's a very less and neglectable difference between the colors.

Comparisons between the cotton and viscose sample of wastage dyeing

Here's the graph of the given table,



7.4.1.4. Table-04

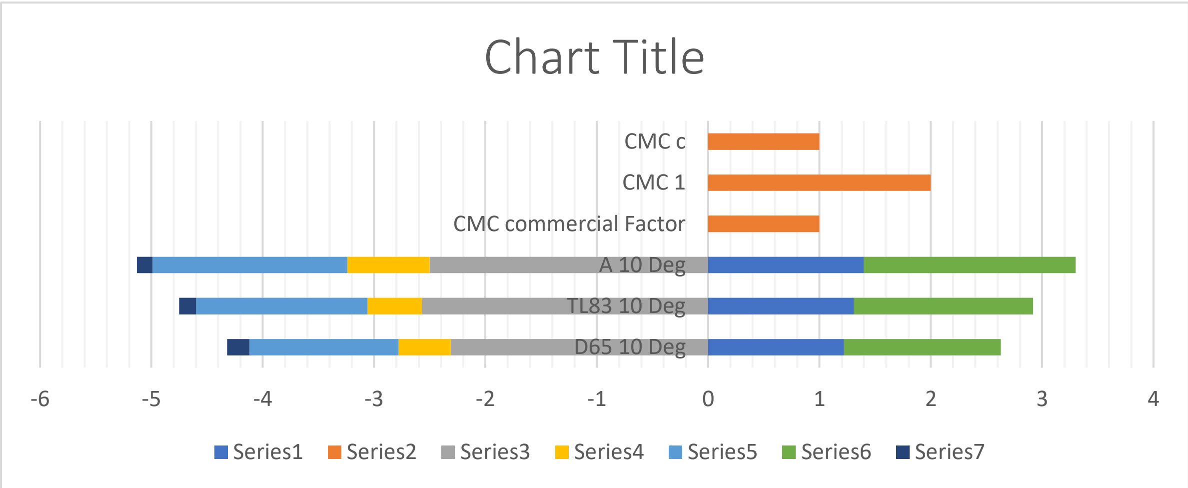
No of Sample	Extra Chemical	CMC DE	Batch comments	Metamerism Index
1. Cotton	Only wastages	1.22	Darker	D 65 vs TL83
2. Viscose			More saturated Greener	0.47

And more,

Table 8.4.1.4.2.

Illuminants	CMC DE*	DL*	Da*	Db*	DC*	DH*
D65 10 Deg	1.22	-2.31	-0.47	-1.34	1.41	-0.20
TL83 10 Deg	1.31	-2.57	-0.49	-1.54	1.61	-0.15
A 10 Deg	1.40	-2.50	-0.74	-1.75	1.90	-0.14
CMC commercial Factor						1.00
CMC 1						2.00
CMC c						1.00

And by the table,



4.2. Fastness Testing:

4.2.1. Wash fastness testing:

a. A multifiber taken $10\times 4\ cm$

b. Stitched to the cut sample.

c. 150ml solution (1gpl $NaBO_3.4H_2O$ and 4gpl ECE det.) and

d. 10 steel balls taken in each pot.

e. Put into the machine for 30 min at 40°C

Here, two tests done in the light box:

1. Color bleeding or color stain to the multifiber
2. Wash fastness / wash comparison with the previous sample

9.4.2. Table-01

Sample no	Color stain in grey scale	Wash fastness with standard in grey scale
1. Cotton	5	5
2. viscose	5	5

4.2.2. Rubbing fastness test:

Two types of test done here. Wet and dry rub. And 10 cycle is taken for each experiment.

10.4.2. Table-02

Sample no	Dry rub fastness	Wet rub fastness
1. Cotton	5	5
2. viscose	5	5

The table shows no color removes by the rubbing action from the sample tested.

*** Here, the color concentration found 0.1114%. which is very lighter. So, all this experiment here shows very good fastnesses.

4.3. Discussion:

From the above results of the experiment, we get light shade by using waste water. Also, the result shows less color is present in the water released after waste dyeing. The color is almost white. Therefore, if the waste water can be kept, it must be used for light shade dyeing at a very low expense. It will lessen environmental damage and be extremely profitable. From the result, the wash fastness and rubbing fastness were excellent. The color concentration is much lighter than expected. This experiment will be very beneficial because limited chemicals are used and chemical costs are reduced. No extra chemicals are used, so time will be reduced. There will be fewer hazardous chemicals and environmental risks in the released water. Overall, the testing showed that both cotton and viscose fabrics exhibit good wash and rubbing fastness properties, with no color removal observed during the testing. The color concentration found in the samples was also very light, indicating good color retention properties. These results are encouraging for manufacturers and consumers, as they suggest that the fabrics are likely to maintain their appearance and color even after repeated washing and rubbing.

Chapter Five

Conclusion:

Salt, soda and dye are the basic chemical of dyeing, though other chemicals used in it. The experiment shown that we will be able to produce light shades by using waste water. Which will have these benefits-

1. No extra chemical has to add
2. Time will be reduced
3. Released water will contain less harmful chemical and less hazards for the environment.
4. Chemical cost reduced.

Mainly observed thing is, after wastage dyeing the water released contains less color. It's almost white. So, if we can preserve the waste water, we must use it for light shade dyeing in very less cost. It will be very profitable and will reduce harm to the environment.

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