



FACULTY OF ENGINEERING

DEPARTMENT OF TEXTILE ENGINEERING

**STUDY ON ANALYZING THE VARIABILITY OF LIGHT WASH
SHADES IN GARMENT WASHING PROCESS.**

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Advance in Wet Processing Engineering

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DECLARATION

We hereby certify that we completed this research under the guidance of **Tanvir Ahmed Chowdhury, an assistant professor** in the textile engineering department of the Daffodil International University faculty of engineering. Furthermore, we affirm that neither this project nor any portion of it has been submitted for consideration for a degree or certificate elsewhere.



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LETTER OF APPROVAL

This project report prepared by Md Shakil Hossain (ID: 201-23-952) and Md Abu Shaikh Bakaul (ID: 201-23-952) is approved in Partial Fulfillment of the Requirement for the Degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING. The said students have completed their project work under my supervision. During the research period I found them sincere, hardworking and enthusiastic.



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***This projects report is dedicated to our
beloved Parents & Teachers***

ABSTRACT

A key component of satisfying consumer desires and market needs in the textile industry is the pursuit of light wash shades in garment washing procedures. With the goal of offering a thorough grasp of the variables determining this variability, this thesis explores the complex problems related to the diversity of light wash shades. This study explores the intricacies involved in clothing washing by examining the interactions among material types, dye qualities, washing methods, and environmental conditions through a thorough literature analysis and methodical experiments. The results of experimental trials show the complexity of the garment washing method via revealing notable differences in light wash tones across various fabric compositions, dye kinds, and washing conditions. Light wash shades are mostly determined by the structure of the fabric, with natural fibers behaving differently than synthetic ones. To further achieve desired light wash shades, the efficiency of washing processes and the ability to absorb of dyes into material fibers are critical factors. Concerns of environmental sustainability and irregular fading patterns, as well as inconsistent dye distribution, are also addressed. The discussion summarizes these results and suggests methods and solutions that could be used to improve the quality and consistency of light wash hues. It is suggested that sustainable practices be incorporated into clothing washing procedures, alternative dyeing techniques be investigated, and washing parameters be optimized. This study advances our understanding of clothing washing techniques and is a useful tool for practitioners, academics, and textile industry stakeholders. The objective of this study is to promote development in garment washing techniques and enable well-informed decision-making by clarifying the challenges involved in achieving light wash shades.

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CHAPTER- 1

INTRODUCTION

1.1 Introduction:

The textile operations, which is always developing to satisfy changing standards and preferences, is at the center of innovation, functionality, and customer demand. Garment washing procedures are essential in this ever-changing environment because they provide a range of finishes that provide fabrics unique textures and visual appeal. Light wash shades are particularly appealing among these finishes because they offer a feeling of timeless charm and informal elegance. But getting consistent light wash colors is a difficult task because there are numerous variables that affect the result while washing clothes. Differences in the composition of the fabric, the properties of the dye, the methods used for washing, and the surrounding environment can all contribute to variation in light wash shades.

Fabric composition includes fundamental changes in the way dyes interact with fibers and how fabrics react after washing procedures. Natural fibers such cotton as well as linen are paired with synthetic counterparts like polyester and nylon. In addition to their depth of penetration, fixation, and migration, dye properties also add to the difficulty of obtaining the right light wash hues. Washing methods that impart distinct effects on fabric surfaces, like enzyme wash, stone wash, acid wash, and bleaching treatments, affect the final shade output. Environmental elements that affect the consistency and effectiveness of clothes washing procedures include temperature changes, water hardness, and chemical interactions.

The ranges in light wash shades pose technical difficulties for textile producers, but they also have an impact on consumer satisfaction, brand equity, and industry sustainability initiatives. Variations in the light wash shades can lead to rejected batches, higher production costs, and a reduction in market competitiveness. Concerns of resource depletion, worker safety, and environmental contamination are also raised by the dependence on chemical-intensive cleaning methods. Understanding the complex interactions between fabric characteristics, dye behaviour, washing methods, and environmental influences is essential to addressing the diversity of light wash hues. Systematic analysis of these characteristics can yield insights for improving quality control procedures, streamlining garment washing procedures, and advancing sustainable practices in the textile sector.

By completing a thorough analysis of the variables affecting the diversity of light wash shades in clothing washing procedures, this thesis aims to be helpful to this effort. This study aims to clarify the details surrounding light wash shades by scientific research as well as theoretical analysis, offering useful information to stakeholders, scholars, and industry practitioners. By expanding our understanding in this area, we hope to promote creativity, sustainability, and quality in clothes cleaning techniques, guaranteeing that light wash hues will always be captivating and motivating in the dynamic field of textiles.

1.2 Objectives of this Study

- To look into the various ways that the wash procedure affects the physical characteristics of denim clothing.
- To know the different washing effects of denim garments.
- To understand the purpose of the various chemicals used in washing.
- To figure out the physical variations in denim garments for the washing procedure
- Comparing the parameters with each other is essential to understanding the changes that occur after enzyme, bleach, and acid washes and sponge ball wash.

1.3 Significant

Understanding the behaviour of garments both before and after washing is crucial for a textile engineer. Generally speaking, this data will assist us with planning, with production, as well as with meeting the needs of the customer fully. But now there's a great chance for us to work for a denim washing plant. So, knowing about denim washing will be essential to our future careers.

CHAPTER-2

LITERATURE REVIEW

2.1 Denim Wash

In the textile industry, washing garments is one of the most sophisticated strategies. Various washing methods can be used, based on the needs of the plan, to improve unique garments looks. Normally garments washing takes place after the sewing process. According to request and design patterns, clients ask that the products of garments be washed. When buyer place a clothing order, always specify what kind of item of clothing washing they require. The items used basically affect the physical changes in garment wash techniques. Because of all the demands that customers have on their garments these days, washing is quite important in the denim industry. The smallest changes in denim piece of garment washing can have a significant impact since indigo colour has an extremely limited slightly wet rate and a dry rubbing. It's essential to monitor every parameter for dependable results. Certain washing techniques give denim items of apparel some noticeable physical changes. Enzyme, bleach, normal, stone, and other washing techniques are among the most often used methods for cleaning denim. Among these washing techniques, dye washing may be one that is used frequently in the industry, particularly when washing denim that has been faded with hypochlorite to get the desired colour shade.

2.2 Types of Denim Washing Process:

2.2.1 Dry Process or Mechanical Washing Process:

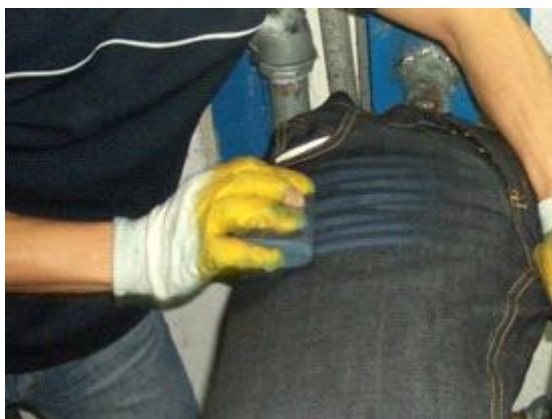
Dry or mechanical methods, these involve washing garments without the use of chemicals or enclosed machinery. Occasionally here task may complete without applying any liquids by using machinery. The essential final stage of washing garments is to look like antique and deform them using various methods such as rubbing, spraying, and harming them.

This carried out to give the garments a stylish and current appearance. Several samples were cleaned using both wet and dry techniques in order to create various designs on the clothing. The scientists examined modifications to objects' motion or physical characteristics. Lastly, and perhaps most importantly, washing an article of clothing without using water has a direct impact on how it appears and functions.

Some of the commonly using dry processes are:

Whiskers:

One of the most important aspects of an old-looking garment is the whiskers. The old lines and imprinting patterns on the hips and front thigh area that result from normal wear and tear are the inspiration behind the whiskers. Many patterns related to the fabric, the user's body type, or sitting position can be found on outdated jeans.



2.1 Figure: 1st Dry Process of Wishkers

Tacking:

The procedure of "tacking" involves using a quick tag machine and plastic or nylon tag pins in a hard shape on the garment to achieve a very heavy contrast (stiff & washed) on the corners of the front and rear pockets, the waistband, and bottom hems, among other places. It needs to be taken out of the clothing once the wash cycle is finished before softening.

- Tacking apply over on garment for a fashion looks like stain mark and value added fashion wear.
- Tacking applied by tagging machines.
- Tacking can be provide also by needle & thread & manually.

Following washing, the top of the garment develops crease marks, and the inside of the label takes on a dark colour.

Grinding

The bottom hems and pocket edges are being rubbed out by running them on a stone or abrasive surface. Manually powered equipment and pen grinding tools come in a wide variety of makes and models.

- Grinding is done on clothing mostly for fashion and an aged or damaged appearance.

- The hem, packet, edge, west belt pocket opening, and pocket fluff of the garment are all crushed.
- Sand paper is ground up by hand, and grinding is done with a grinding machine.



2.2 Figure: Grinding effect edge point

Damages/Destruction:

"Destruction," one of the most well-liked distressing effects right now, is a skill that gives denim a damaged, unique appearance. In the middle of the washing procedure, a stone tool similar to a destruction pen is applied to the desired area. Another way to do it is to retain the weft yarn intact and cut the warp yarns with a knife so that the white thread shows through. Cutting weft and warp threads can also be used to create holes. Since these are all handmade methods, each garment will have a distinct appearance from the others.



2.3 Figure: Destruction after 1st wash

Wrinkle / Crinkle:

Resin that is free of formaldehyde is used to create 3D effects, rigid looks, etc. The clothing can be treated in this manner by either spraying or dipping it in a solution including Resin, Catalyst, Silicone, and PU, adjusted for the fabric strength and required effect.

In order to achieve a three-dimensional impression, manually design the thigh, hip, and back knee area after applying the resin solution in the proper proportion. Following creation, it needs to be manually dried using a heated press or before being properly cured in an oven at the specified temperature and duration as specified in the resin product handbook.

If resin is not fully cured, the person who wears it may experience skin irritation or rashes and the 3D impression will not last forever. This process requires highly competent operators to carry out in order to achieve uniformity & consistency.



2.4 Figure: Wrinkle test

2.2.2 Wet Process or Chemical Washing Process:

Using chemicals and washing machines to wash garments is a regular practice. The term for this procedure is chemical or wet washing. It is possible to utilize a wide variety of chemicals. It is very important to wash garments since it improves their appearance. The process of making the clothing is also modified. We are aware of the various methods for washing garments to improve their appearance. There are numerous approaches to wash garments, including various chemical formulations and methods of operation. These include of stone wash, stone enzyme wash, sponge ball washing, towel bleach washing, bleach washing, and acid washing.

The function of chemicals used in washing plant:

Detergent: The chemical composition of this liquid, glycolic solution is fatty alcohol polyglycol ether. Detergent pre-treatments can be applied consistently or sporadically to all types of fibre and their mixes. It applies to garments to remove sizing and mineral oil-related impurities.

Enzyme: the enzyme's activities throughout an enzyme wash as the cellulose breaks down. It starts by targeting the projecting fibres and hydrolyzing them. Next, the fabric's yarn component is attacked and hydrolyzed. As a result, the yarn component drains colour, providing the garment a worn-in and rough appearance.

Bleaching powder: An oxidising agent is bleaching powder. Bleaching powder is one type of oxidising agent. It's used in laundry machines to take colour out of denim garments. We can obtain different colour tones (dark, medium, and light shade) on the clothes.

Acetic acid (CH_3COOH): Acetic acid is used to balance the pH in the wash bath and prevent the negative effects of the alkaline state on the clothing.

Anti-stain: Anti-stain serves as an anti-creasing agent as well as a stain preventer for white denim weft yarn, levels, touched textiles of clothing, and white garment pockets.

Sodium hyposulphite: Sodium hyposulfite is utilized for countering the bleach that contains chlorine on the clothing.

Soda ash: Soda ash creates an alkaline medium that helps in the pigment colour damage process. The bleaching action of the bleach solution is more uniform when soda ash is added.

It has purifying qualities and mitigates the effects of the clothing's colour fading. It also serves as a colour fixer in the dye bath.

Caustic soda: Caustic has excellent cleaning properties and is essential to the bleaching process while not affecting the colour of the garments. It gives garments a rapid fading or damaged appearance.

Sodium bicarbonate: Sodium bicarbonate is used in bleach washes with bleaching powder for light-colored denim since the colour fades quickly. Consequently, cheap costs and increased productivity are achieved.

Softener: Clothing-making textiles are given a soft, smooth surface and good lubricating properties by the application of softeners. Put the machine to use with diluted hot water-based cationic or non-ionic softener.

Potassium permanganate (PP): In order to remove colour off clothing, a solution of potassium permanganate (PP) is applied in an acid wash along with a pumice stone, thermosol ball, or towel. It is applied to the clothing using a nozzle in the chamber where it is sprayed to remove colour (create a white imprint).

Sodium chloride: It allows dye absorption into the fibre.

Hydrogen peroxide: Gray fabric products can be cleaned, bleached, or made ready for dyeing with hydrogen peroxide. Hydrogen peroxide plays a vital role in the bleach wash procedure. When hydrogen peroxide degrades in an alkaline medium, some per hydroxyl ions are released, which discolour the colouring agents, causing a fading effect. It can also be applied to garments to counteract an alkaline state.

Stabilizer: Hydrogen peroxide works best while its operating temperature is above 90 °C; when the temperature hits 90 °C, it decomposes. There must be a stabilizer present to stop the breakdown of hydrogen peroxide.

Buffer: Buffer is applied in washing to control the pH of the desizing, softener, and enzyme baths.

Fixing agent: A fixing agent serves to enable unfixed dye to bond to textiles. Both colour fastness, rubbing fastness are enhanced when the colour of the cloth is correctly fixed.

Resin: The highly efficient resin depends on etherified dimethylol glyoxalin monoureine urea. Resin can be used to create semi-permanent wrinkles on denim and other cellulose materials. Cloth made of polyester and cotton is also utilised. A fabric's gentle handling is maintained after washing.

Sodium Metabisulphite: Sodium metabisulphite is used to neutralise potassium permanganate during the washing process.

Desizing agent: A desizing agent is primarily used to remove pectins, lipids, waxes, starches, and unfixed indigo dye from fabrics such as denim, twills, poplin, and canvas.

Optical brightener: Red and blue optical brighteners, considered to be two distinct kinds of brighteners, are used in the washing plants. Optical brighteners are typically used to make garments brighter.

Anti-back staining agent (ABS): In order to prevent indigo or dye molecules from depositing on clothing, dispersing agents are widely utilised in the denim apparel industry. For this reason, the dispersing agents are often referred to as anti-backstaining agents.

2.3 Types of wet washing process applied in garments:

The wet or chemical washing procedure, which can be performed using a range of chemical agents and clothes-loading washing machines, is one of the most often used techniques. These are a few illustrations of several wet wash techniques applied to apparel.

- Normal wash or rinse wash
- Stonewash
- Enzyme wash
- Stone enzyme wash
- Bleach wash
- Acid wash
- Towel bleach wash
- Garments dyeing

2.3.1 Normal wash or rinse wash:

Conventional washing is the most common, straightforward, and cost-effective form of washing. Almost all purchasers consider this to be necessary. During the routine washing production process, certain unwanted elements like starch, dirt, and grime are eliminated without shrinking. Loose dyes can be removed to increase colour fastness on cooler clothes. Regular washing can occasionally soften and give the clothing a worn-out appearance. The temperature, time, and detergent dosage can all be altered to alter the washing result on the clothing's surface. Certain types of clothing have the ability to shrink on their own. There are other terms for conventional washing, such as rinsing, bleaching, and conventional washing.

2.3.2 Desizing

The warp is cleared of the sizing substance. This is the simplest method for cleaning denim. Sizing chemicals are applied to the warp yarns. During the weaving process, sizing agents are chemicals that offer cloth strength and abrasion resistance. Sizing serves to protect the warp threads. The desizing process involves the employment of a variety of sizing chemicals, including polyester, polyacrylate, starch, modified starch, polyvinyl alcohol, polyvinyl acetate, and CMC. To provide the fabric the right appearance while washing, these chemicals have to be eliminated.

2.3.3 Stone wash

Pumice or volcanic rock is applied as an abrasive during washing. The fading is more pronounced but not uniform. Stonewashed denim goods give off an air of vintageness, wear and tear. Clothes wear that alternates is the source of this. Traditionally, pumice stones are used to wash denim items in order to provide them a smooth texture and appealing appearance. During the cleaning process, an abrasive is an oval or round-surfaced, rough pumice stone. Denim fabrics undergo variations in shape, composition, hardness, and porosity, which might affect the way they wash. After washing, these stones remove the colour from the denim's surface by scraping the threads, giving the material a faded, worn-in, and glossy appearance.

The surface of the fabric is brushed with the pumice stone. Greater brushing action will cause areas to fade more quickly, whereas less scrubbing effort will cause parts to discolour more slowly. places of fabric with many layers, such pockets, collars, cuffs, button plackets, and side seams, are brushed with greater force than places with only one layer of cloth. The garments will fade unevenly as a result of the pumice stone's effect. The top exporters of pumice stones worldwide are the United States, Iceland, Japan, New Zealand, Turkey, Germany, Italy, Indonesia, and the Philippines.



2.5 Figure: Pumic Stone

2.3.4 Using Enzyme to Wash Denim (With or Without Stone):

Using the enzyme cellulase, pale denim grows. Jeans are made with indigo warp yarn. Referred to as "ring dyeing" informally, the majority of the colour is absorbed onto the fibre surface during this process. Denim seems faded because the cellulose enzyme corrodes the fibre surface, exposing the undyed substance of the fibre. Stains can be removed more easily using mechanical abrasion. Previously, to get the desired effect, denim had been washed with a pumice stone. Thus, the use of the stones has been encouraged by the cellulose enzyme. When the indigo dye is added to the washing mixture while the washing process, the solution becomes dark blue. Indigo dye's two amine groups have the ability to protonate in an acidic environment. Conversely, in acidic conditions, cellulose maintains its negative charge while

dyes undergo protonation, which results in the acquisition of an overall positive charge. Positive and negative charges are attracted to one another in a solution. As a result, indigo prefers cotton with an acidic pH. A portion of this indigo was transferred to the denim's whiter sections, diluting the stonewash effect's colour contrast. "Back staining" is the term for this condition. The issue of reverse staining is exacerbated by acid cellulase. Neutral cellulose is a better option for managing the re-staining issue because to its resilience to fading and better control over fading effects.

2.3.5 Acid wash

Acid washing denim is becoming more and more popular because of its eye-catching contrasts and appealing colour appearance. The uppermost layer of the fabric was dyed white and given a worn look, while the bottom surface of the denim retained its original colour thanks to a chemical wash procedure. It can be used on foundation materials dyed with sulphur and indigo. The two primary ingredients in acid washing are potassium permanganate, sometimes referred to as KMnO_4 , and phosphoric acid, sometimes called orthophosphoric acid. Use moist towels or pumice stones to alter the appearance of denim garments. Sodium metabisulfate is used in the second washing to neutralise the solution.

2.3.6 Bleach wash:

Bleach wash is one method of cleaning clothes that makes use of a strong oxidative bleaching agent. Sodium hypochlorite (NaOCl) and potassium permanganate (KMnO_4) are examples of bleaching agents. Colour can be reliably erased from the fabric and has been removed in compliance with requirements (per the buyer's wash authorization) by employing a bleaching chemical. It is important to recognise the three forms of bleaching: light bleach (where the majority of colour is removed), medium bleach, and dark bleach. Indigo-dyed denim is cleaned with either low power KCI bleach (containing 30% chlorine) or high power Japan bleach (containing 60% chlorine), depending on the design. A distinctive form of fading effect can be produced in the clothing by applying a bleaching wash. Temperature, treatment duration, and the quality of the bleach liquid all affect how much discoloration is produced. It

is better to use a strong bleach that you can apply rapidly. If the bleaching chemical is adequately rinsed, the yellowing effect that occasionally arises from this approach can be minimised. In this instance, the bleaching agent can be eliminated from the clothing with just two rinses. Prior to usage, the bleaching agent must be neutralised. In this case, sodium hypo- or sodium Meta bi-sulfite is used to neutralise the bleaching agent from the clothes. Because of their strong bactericidal properties, most bleaches are hazardous to human beings and should only be used under close supervision.

2.3.7 Acid Washing Process with towel bleach:

After being presoaked in a solution containing a potent oxidising agent, like potassium permanganate, and getting any extra solution removed, towels are applied to the clothing using dry tumbling. This leads to a clear blue/white contrast as well as a localised washing effect.

2.3.8 Ozone wash:

Ozone, an inorganic molecule, has the chemical formula O_3 . Ozone is one of the strong oxidizers (O_3). Colour changes are washed in with a contemporary method called ozone wash. The object can be bleached using this method. Denim items can be bleached in a washing machine with ozone in both dry and wet settings. Ozone washing uses less energy and natural resources and eliminates the need for water, chemicals, time, and mechanical action to clean garments, unlike conventional washing. When electricity and oxygen are combined, ozone gas is created, which is then fed through the washing machine to be processed. Ozone is introduced into a washing machine by dissolving it in water rather than using chemicals. This transition is one of the crucial textile processing phases that reduces operating costs and restores the efficacy of denim washing. Ozone washing technologies lessen the effect of traditional washing system operations on the environment.

Factors affecting ozone fading:

- **Impact of Gas Concentration:** The concentration of ozone gas has little to no impact on any of the mechanical characteristics of denim fabric. This is because increasing the concentration of ozone gas will speed up the machine and shorten the treatment time, respectively. The denim fabric's ability to withstand tears is therefore unaltered. Tear

strength, however, will surely decrease if gas concentration rises while time and speed stay the same.

- **Influence of Speed:** Ozone first strengthens the fabric, but as speed rises, the strength of the tear falls. This explains why the tear strength immediately increases with rate up to a limit of 15 rpm before starting to decline above this number.
- **Time's Influence:** Tears lose their strength with passing time. Strength decreases as a result of the machine's closer interaction with the fabric and gas abrading the denim's surface.

CHAPTER-3

METHODOLOGY

Sample-1

3.1 Enzyme Wash

Process flow Chart-

1st Wash-

Desize



Liquid



Neutral



Rinse



Oz-One



Scouring



Rinse



2nd Wash-

Enzyme



Fixing



Softener

3.1.1 Material Statement of the Process-

Desize: After a textile fabric is woven, the size material is removed from the warp threads by a process called desizing.

Rinse: Rinse wash refers to a room-temperature water wash. Rinse denim refers to keeping denim clothing's raw denim effect intact without undergoing any colour fading.

Scouring: A preliminary treatment for some textile materials is scouring. Oils, waxes, fats, vegetable matter, and dirt are examples of natural, added, and accidental contaminants that are removed from textiles through scouring. Scouring these impurities out of the fabrics gets them ready for other steps like bleaching and dyeing.

Enzyme: The textile industry frequently uses enzymes including catalase, laccase, and cellulases. These enzymes are utilised for whitening fabrics, breaking down lignin, eliminating starch, and breaking down excess hydrogen peroxide.

Fixing Agent: Unfixed dyestuff on the surface of dyed fabric may result in colour migration when wet or after washing if the fabric is used to create finished goods. A fixing agent needs to be applied to the coloured fabric in order to fix the unfixed dyestuff on the fabric. The fabric's quality and wet colour fastness are improved.

Softener: Finishing compounds called softeners are used on textile materials to give them a pleasant feel and touch. Generally speaking, the softening compounds used are lubricants, which make it simpler for the fibres to slide inside the structure of the fabric, allowing for easier fabric wrinkling and distortion.

1st Wash Information (Chemical & Doses)-

Process Name	Chemical Name	Dosage (gm)	Total Water (Ltr)
Desize	Amylase	100	80L
	Resperse ABS	100	
Liquid	BE-700	100	80L
Neutral	Meta	100	50L
Rinse ×2			50L+50L
OZ-One	10%		N/A
Scoring	Green Buff 1000	100	
	H ₂ O ₂	100	
	Resperse ABS	100	
Rinse ×2			50L+50L

3.1 Table: 1st Wash Recipe (Enzyme Wash)

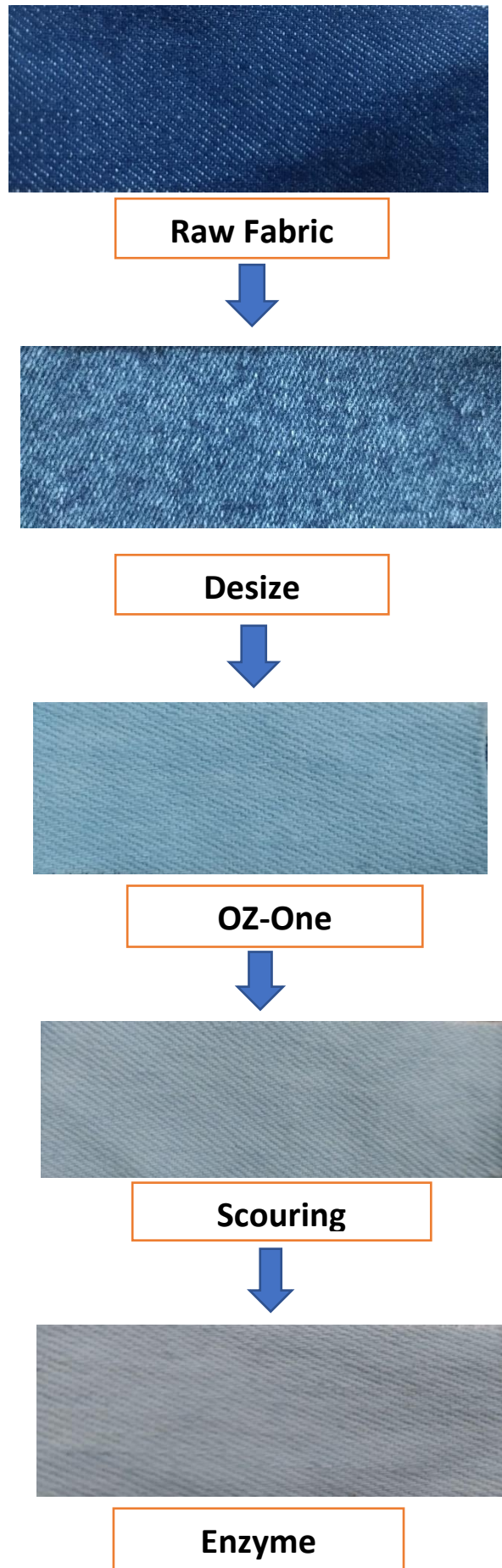
1st Wash Information (Time & Temperature)-

Process Name	Temp. C	Time (min)
Desize	50°C	10
Neutral	R/T	5
Rinse	R/T	2
OZ-One	R/T	1
Scouring	40°C	10
Rinse	R/T	2

2nd Wash Information (Chemical, Dosage, Temp, Time)-

Process Name	Chemical Name	Dosage (gm)	Total Water	Temp. C	Time (min)
Enzyme	Brown G.T.L	0.1			
	Resperse ABS	100			
Fixing	F.F-25	210	30L	45°C	5
Softener	Nobel Soft	200	30L	R/T	2

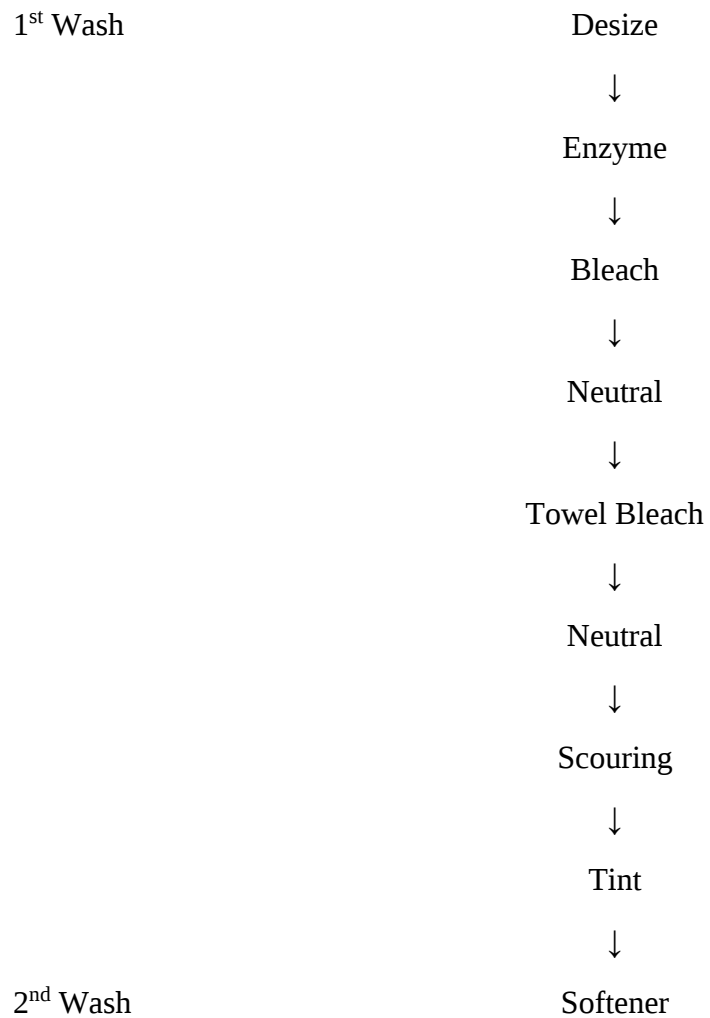
3.2 Table: 2nd Wash Recipe (Enzyme Wash)



Sample 2

3.2 Towel Bleach Wash

Process flow Chart-



3.2.1 Material Statement of the Process-

Desize: After a textile fabric is woven, the size material is removed from the warp threads by a process called desizing.

Enzyme: The textile industry frequently uses enzymes including catalase, laccase, and cellulases. These enzymes are utilised for whitening fabrics, breaking down lignin, eliminating starch, and breaking down excess hydrogen peroxide.

Bleach: Wet processing proceeds to its third step, bleaching. Bleaching is the process of taking a fiber's natural colour out and turning it into a dazzling, pure white textile material.

Its Objective-

- to take away the original hue.
- to permanently brighten and whiten the fabric.
- to boost the cloth's capacity for absorption.
- to improve the affinity of the dye.
- to provide even colouring properties.
- to prepare the fabric for the following procedure.

Neutral: After the bleaching process, neutralisation is an essential stage in denim washing because it helps eliminate any remaining chemicals and shields the fabric from further damage. In the denim washing industry, sodium metabisulphite is frequently employed as a neutralisation agent and calcium hypochlorite is primarily used as a bleaching agent.

Scouring: A preliminary treatment for some textile materials is scouring. Oils, waxes, fats, vegetable matter, and dirt are examples of natural, added, and accidental contaminants that are removed from textiles through scouring. Scouring these impurities out of the fabrics gets them ready for other steps like bleaching and dyeing.

Tint: Tinting is a technique that uses primarily straight dye and very little additional colouring. The purpose of this is to alter the indigo's hue, cast, and tone. Clothing can be tinted to give it a worn-in, dirty appearance.

Softener: Finishing compounds called softeners are used on textile materials to give them a pleasant feel and touch. Generally speaking, the softening compounds used are lubricants, which make it simpler for the fibres to slide inside the structure of the fabric, allowing for easier fabric wrinkling and distortion.

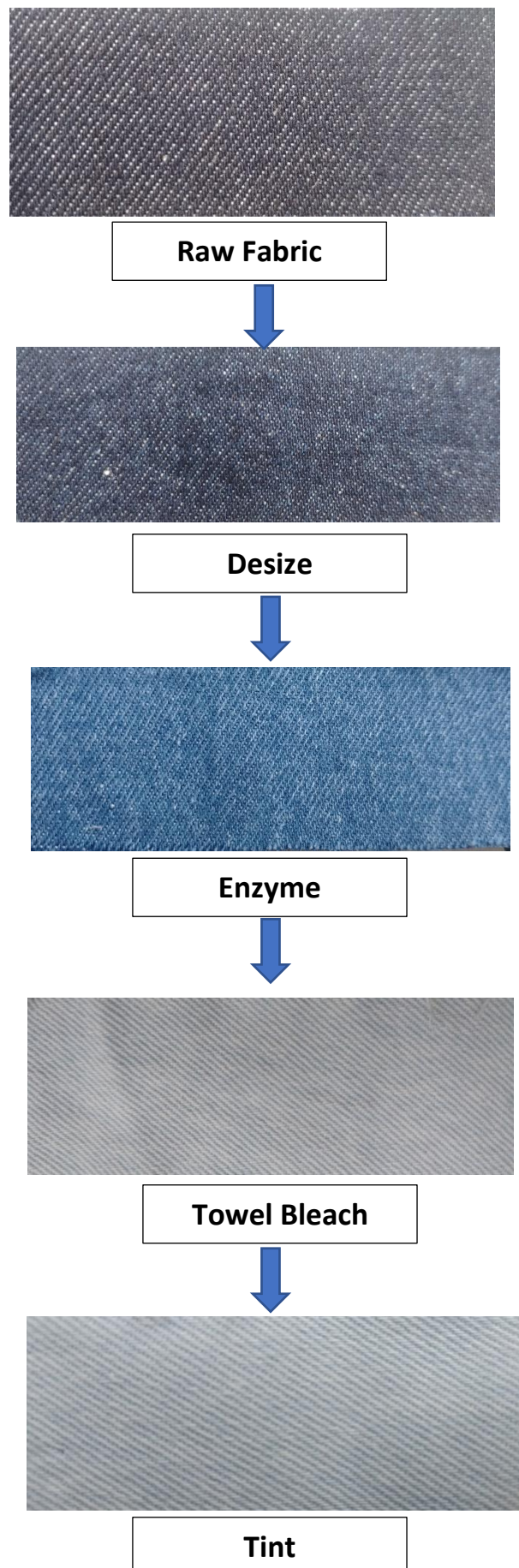
1st Wash Information-

Process Name	Chemical Name	Doges (gm)	Temp.° C	Time (min)
Desize	MHS	200	45° C	10
	ABS	50		
Enzyme	P Wash AK	50	45° C	20
	ABS	50		
Bleach	Japani	3Kg	50° C	20
Neutral	Meta	200	R/T	5
Towel Bleach	Japani	500	45° C	25
Neutral	Meta	200	45° C	5
	H ₂ O ₂	100		
Scouring	Soda	100	45° C	3
	H ₂ O ₂	100		
Tint	Red	100		

3.3 Table: 1st Wash Recipe (Towel Wash)**2nd Wash Information-**

Process Name	Chemical Name	Doses	Temp	Time
Softener	C.H.W	300	R/T	5

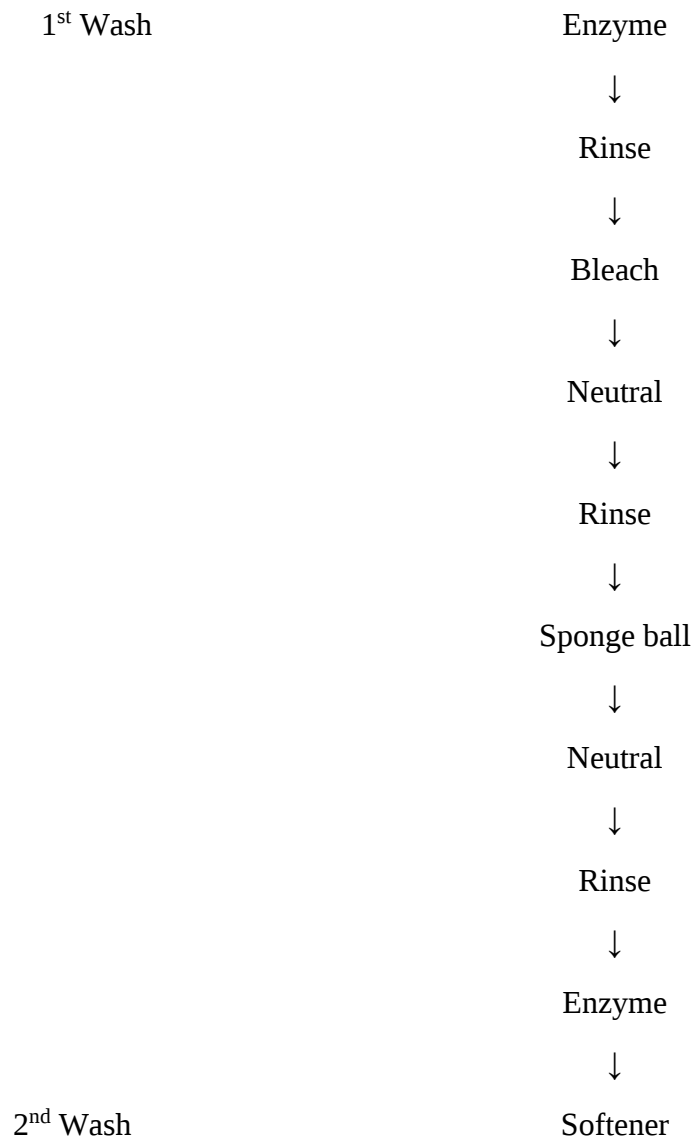
3.4 Table: 2st Wash Recipe (Towel Wash)



Sample 3

3.3 Sponge Ball Wash

Process flow Chart-



3.3.1 Material Statement of the Process-

Enzyme: The textile industry frequently uses enzymes including catalase, laccase, and cellulases. These enzymes are utilised for whitening fabrics, breaking down lignin, eliminating starch, and breaking down excess hydrogen peroxide.

Rinse: Rinse wash refers to a room-temperature water wash. Rinse denim refers to keeping denim clothing's raw denim effect intact without undergoing any colour fading.

Bleach: Wet processing proceeds to its third step, bleaching. Bleaching is the process of taking a fiber's natural colour out and turning it into a dazzling, pure white textile material.

Its Objective-

- to take away the original hue.
- to permanently brighten and whiten the fabric.
- to boost the cloth's capacity for absorption.
- to improve the affinity of the dye.
- to provide even colouring properties.
- to prepare the fabric for the following procedure.

Neutral: After the bleaching process, neutralisation is an essential stage in denim washing because it helps eliminate any remaining chemicals and shields the fabric from further damage. In the denim washing industry, sodium metabisulphite is frequently employed as a neutralisation agent and calcium hypochlorite is primarily used as a bleaching agent

Sponge ball: Sponge Washing Balls are used for hypo and KMnO_5 , and their sponge rubber construction allows users to apply various random effects to clothing.

Softener: Finishing compounds called softeners are used on textile materials to give them a pleasant feel and touch. Generally speaking, the softening compounds used are lubricants, which make it simpler for the fibres to slide inside the structure of the fabric, allowing for easier fabric wrinkling and distortion.

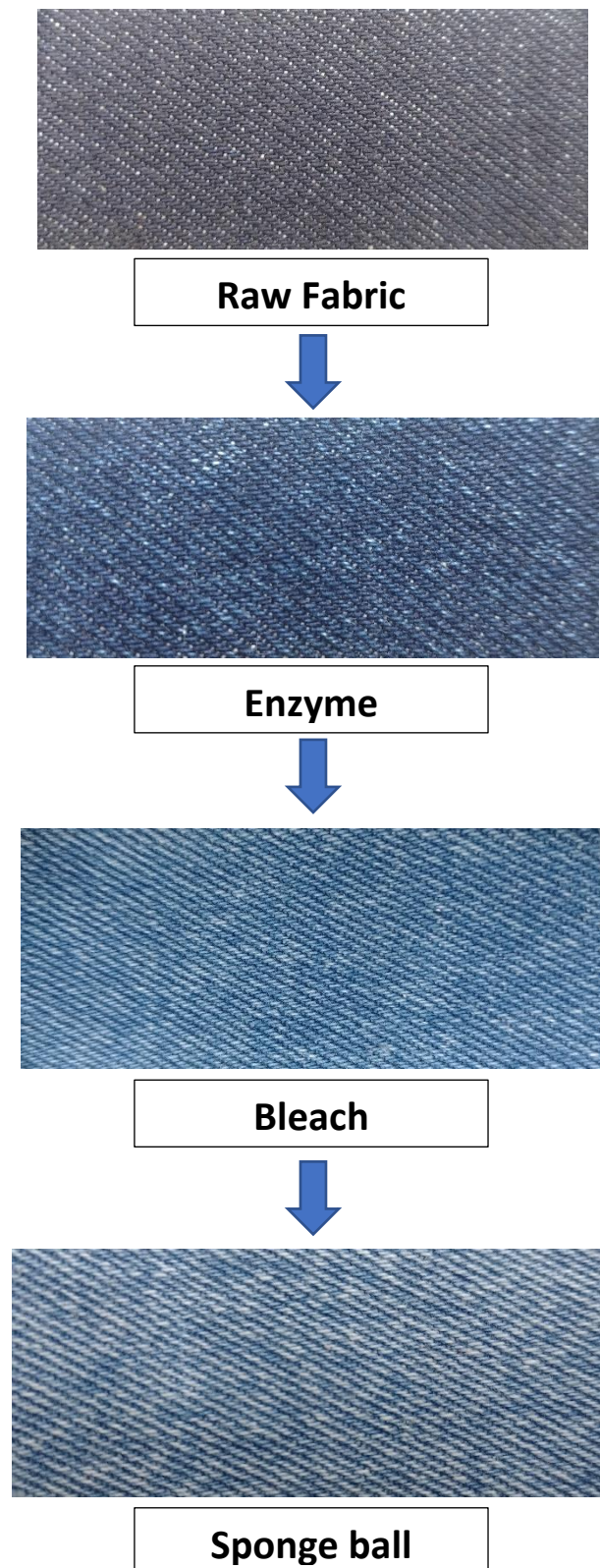
1st Wash Information-

Process Nmae	Chemical Name	Doges (gm)	Total Water	Temp. °C	Time
Enzyme	Blue Breeze	20		45°C	30
	ABS (Without Stone)	30			
Rinse			100L	R/T	1
Bleach	Indian	100		45°C	20
Neutral	Meta	100		R/T	5
Rinse			100L		1
Sponge ball	Potash	4 gm	1L	R/T	15
	Acid	2 gm			
Neutral	Meta	200	80L	R/T	5
Rinse×2			100L	R/T	2

3.5 Table: 1st Wash Recipe (Acid Wash)**2st Wash Information-**

Process Nmae	Chemical Name	Doges (gm)	Total Water	Temp. °C	Time
Softener	Nobel Soft & MA	50 & 20	30L	R/T	3

3.6 Table: 2st Wash Recipe (Acid Wash)



CHAPTER-4

RESULTS & DISCUSSION

4.1 Tearing Strength Tests:

Tearing Strength Test Report:

For Enzyme wash treatment-

Test Report	Requirement	Result		
Color: Light Indigo		Steps of treatment	Observations	Rating
Warp	20 N	Desize	78.31N	Pass
		Oz-one	74.67N	
		Enzyme	47.45N	
Weft	15 N	Desize	45.12N	Pass
		Oz-one	48.46N	
		Enzyme	28.27N	

For towel bleach wash treatment-

Test Report	Requirement	Result		
Color: Light Indigo		Steps of treatment	Observations	Rating
Warp	20 N	Desize	78.48N	Pass
		Enzyme	64.45N	
		Towel bleach	48.10N	
Weft	15 N	Desize	45.14N	Pass
		Enzyme	38.82N	
		Towel bleach	28.16N	

For Sponge ball wash treatment-

Test Report	Requirement	Result		
Color: Light Indigo		Steps of treatment	Observations	Rating
Warp	20 N	Enzyme	64.27N	Pass
		Bleach	61.58N	
		Sponge ball	55.29N	
Weft	15 N	Enzyme	38.52N	Pass
		Bleach	33.84N	
		Sponge ball	29.36N	

4.2 Color Fastness to Washing

For Enzyme wash treatment-

Test Method: ISO 105-C06

Colorfastness to Washing	Requirement	Test Results	Rating
COLOR CHANGE	4	4.5	PASS
SELF STAINING	4.5	4.5	PASS
COLOUR STAINING (ACETATE)	4	4.5	PASS
COLOUR STAINING (COTTON)	4	4.5	PASS
COLOUR STAINING (NYLON)	4	4.0	PASS
COLOUR STAINING (POLYESTER)	4	4.0	PASS
COLOUR STAINING (ACRYLIC)	4	4.5	PASS
COLOUR STAINING (WOOL)	4	4.0	PASS

For towel bleach wash treatment-

Test Method: ISO 105-C06

Colorfastness to Washing	Requirement	Test Results	Rating
COLOR CHANGE	4	4.5	PASS
SELF STAINING	4.5	4.5	PASS
COLOUR STAINING (ACETATE)	4	4.5	PASS
COLOUR STAINING (COTTON)	4	4.5	PASS
COLOUR STAINING (NYLON)	4	4.5	PASS
COLOUR STAINING (POLYESTER)	4	4.5	PASS
COLOUR STAINING (ACRYLIC)	4	4.5	PASS
COLOUR STAINING (WOOL)	4	4.5	PASS

For Sponge ball wash treatment-

Test Method: ISO 105-C06

Colorfastness to Washing	Requirement	Test Results	Rating
COLOR CHANGE	4	4.5	PASS
SELF STAINING	4.5	4.5	PASS
COLOUR STAINING (ACETATE)	4	4.5	PASS
COLOUR STAINING (COTTON)	4	4.0	PASS
COLOUR STAINING (NYLON)	4	4.5	PASS
COLOUR STAINING (POLYESTER)	4	4.5	PASS
COLOUR STAINING (ACRYLIC)	4	4.0	PASS
COLOUR STAINING (WOOL)	4	4.0	PASS

4.3 Colorfastness to Rubbing:

For Enzyme wash treatment-

Test Method: BS EN ISO 105

Colorfastness to Rubbing	Requirement	Test Results	Rating
Dry Crocking	3.0	4.5	Pass
Wet Crocking	2.5	4.0	

Table: Colorfastness to Rubbing

For towel bleach wash treatment-

Test Method: BS EN ISO 105

Colorfastness to Rubbing	Requirement	Test Results	Rating
Dry Crocking	3.0	4.5	Pass
Wet Crocking	2.5	4.5	

Table: Colorfastness to Rubbing

For Sponge ball wash treatment-

Test Method: BS EN ISO 105

Colorfastness to Rubbing	Requirement	Test Results	Rating
Dry Crocking	3.0	3.5	Pass
Wet Crocking	2.5	3.0	

Table: Colorfastness to Rubbing

Conclusion:

To sum up, this thesis has looked into how different light wash hues can be when washing clothes. Several important conclusions have been drawn after extensive investigation, testing, and analysis. These conclusions provide light on the variables influencing the diversity of light wash colours and offer insightful information to the clothing industry.

First off, the results of light wash shades have been shown to be highly influenced by the choice of chemicals and washing technique. Because different washing methods have different effects on fabric texture and dye retention, such as enzyme wash, stone wash, or bleach wash, they produce different hues. Furthermore, by influencing the colour strength and hue, the choice of detergents, bleaches, and other chemicals is critical in deciding the final shade.

Second, it has been determined that a significant factor influencing variations in light wash hues is the makeup of the cloth. Because different materials have distinct structures, capacities for absorbing colour, and levels of chemical reactivity, fabrics made of different materials like cotton, denim, or blends—respond differently to washing procedures. In order to achieve consistent results across various fabric kinds, it is imperative to comprehend these variances.

Moreover, a detailed investigation has been conducted into the impact of process parameters, such as temperature, time, and agitation intensity. It has been discovered that little adjustments to these factors can result in notable changes to light wash shades, underscoring the significance of exact control and washing condition optimisation to reliably achieve desired results.

Furthermore, it has been determined that environmental variables and water quality can also be external sources of variation in light wash hues. Water impurities, temperature and humidity swings, and other environmental variables might affect how well washing procedures work and what shade is achieved in the end.

Subsequent studies in this area may investigate sophisticated methods of process optimisation, including computer modelling and simulation, to improve our comprehension of light wash variability and create novel approaches to get dependable and adaptable results. Furthermore, research on environmentally friendly substitutes and sustainable methods for cleaning clothing could help allay growing worries about the effects on the environment and encourage ethical production methods in the sector.

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