Faculty of Engineering

Department of Textile Engineering

Comparative Study on Water Consumption in Denim Manufacturing

Course Code: TE4214

Course Title: Project (Thesis)

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A thesis submitted in partial fulfillment of the requirements for the degree of **Bachelor of Science in Textile Engineering**

Advance in Fabric Manufacturing Technology

June13 , 2023

LETTER OF APPROVAL

June 01, 2023

To

The Head

Department of Textile Engineering

Daffodil International University

Daffodil Smart City (DSC), Ashulia, Savar, Dhaka-1216

Subject: Approval of Project Report of B.Sc in TE Programe

Dear Sir

I am just writing to let you know that this Project report titled as **Comparative Study on Water Consumption in Denim** have prepared by the student bearing ID 192-23-5558, Kallol Saha, and ID 192-23-5668, Md Hamim Khan, is completed for final evaluation. The whole report is prepared based on the proper investigations and interruption through critical analysis of empirical data with required belongings. The students were directly involved in their project activities and the report become vital to spark of many valuable information for the readers.

Therefore, it will highly be appreciated if you kindly accept this report and consider it for final evaluation.

Yours Sincerely

Prof. Md Mahbubul Haque

Professor & Program Director, M.Sc

Department of Textile Engineering

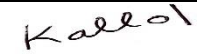
Faculty of Engineering

Daffodil International University

DECLARATION

We hereby declare that the work which is being presented in this thesis entitled, **Comparative Study on water consumption in denim** is original work of our own, has notbeen presented for a degree of any other university and all the resources of materials used for thisthesis have been duly acknowledged.

Prepared by:

NAME	ID	Signature
Kallol Saha	192-23-5558	
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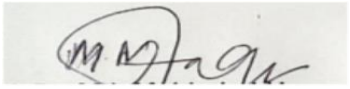
This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

Supervisor



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ACKNOWLEDGEMENT

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Lastly, we would like to express my gratitude to all the individuals who participated in this study, providing their time, insights, and experiences. Their contributions have been fundamental to the empirical findings presented in this thesis.

ABSTRACT

This thesis aims to provide a complete evaluation of the function of Water Consumption of Denim Fabric Manufacturing in Sheet Dyeing Machines. Through inspecting diverse theoretical frameworks, empirical studies, and realistic packages, this study explores the significance and effect of Water consumption of Denim Fabric manufacturing specially in Dyeing Sizing on slasher Dyeing Machines. The study employs a scientific technique, utilizing each qualitative and quantitative research strategies to gather and examine information from numerous sources.

The research starts off evolved with a thorough literature overview, encompassing relevant studies, theories, and ideas associated with Water consumption of Denim cloth production inside Sheet Dyeing Machines. In the end, the study investigates the key drivers, challenges, and possibilities associated with Water consumption of Denim fabric manufacturing, losing mild on its multifaceted nature.

Furthermore, this study presents an in-depth analysis of how much water required for 3 sheet dyeing machines for manufacturing denim fabric & the empirical findings derived from primary and secondary data sources. Through rigorous data collection techniques, such as surveys, interviews and case studies, the findings explores the real-world implications and practical applications of Water Consumption of Denim Fabric Manufacturing. The findings provide valuable insights into the various dimensions like Water consumption of denim fabric differs from Yarn's count, dye & weight wise variation.

Contents:

List of Table:

List of Figure:

List of Graph:

CHAPTER–1
INTRODUCTION

The textile industry makes substantial use of water. The manufacture of denim fabric tops the list of water uses and pollution in the textile industry. With each pair of jeans requiring 2900 gallons (or around 11,000 L) of water, it is at the top of the list of fabrics that consume the most water. Additionally, washing, finishing, and dyeing processes pollute water in proportion to the amount they use. Today's consumers care about a product's environmental effect in addition to its quality and appearance. Furthermore, to the financial expense, they should be informed that making a pair of jeans entails enormous environmental costs. Companies or organizations can develop a plan for improvement projects using denim water consumption estimation, which may also enable the assessment of the impact of water consumption in a particular geographic area or territory on thirst or water scarcity in that location. Humans are forced to consider water supplies and water quality due to changes in climate, water usage, and water pollution. Due to this condition, there is a water shortage that needs to be analyzed, evaluated, estimated, and guarded against.

Water losses via evaporation, escape into another catchment area, return to the sea, or incorporation into a product are referred to as "consumption." It also includes water that is withdrawn during the off-season and returned during a wet period, for example. The quantity of water required to make a pair of jeans varies on several factors, including geography, irrigation technique, farmers' knowledge of water management, the amount of raw materials used, and production of the latest technology.

Synthetic indigo produced from components extracted from fossil fuels is used for coloring denim. Cotton is taken out of bales, carded (put through brushes), spun into cotton thread, and then the end product yarn is indigo colored. Before being weaved with white yarn, it is initially treated with starch to make it stiffer which is named as Denim.

1.1 Objectives of the Study

1. To get an idea about the amount of water required to manufacture denim fabric;
2. To compare the many fiber, yarn, and dye types used to make denim fabric;
3. To compare the water usage of various counts of yarn;
4. To comprehend the effects of freshwater resources being appropriated by humans and exploited to make jeans
5. To compare the amount of water required for denim production with the amount that is available in any given place and at any given time.

1.2 Scope of the Study

This study's focus on the textile industry is extensive. It will undoubtedly be beneficial to us in the future if we try to understand and memorize all the procedures and approaches. All procedures and techniques are crucially important. Based on various yarn counts, fibers, and dyes utilized during that procedure, we attempt to compare the water consumption of denim fabric.

1.3 Limitation

We ran into the following issues while working on our thesis:

1. Due to a number of constraints, we are unable to gather some raw data from the finishing and maintenance department.
2. The lack of time is another major issue for us. If we could have stayed for a few more days, we could have learnt more about the sectors where we spent our two-month internship and gathered more useful information.
3. We are unable to get some internal documents without approval from higher authorities reports from inspections and lab tests in particular.

CHAPTER–2
LITERATURE REVIEW

1. According to (Choudhury, 2017) to manufacture one pair of jeans requires about 1.5 lbs. of cotton. For 1.5 lbs. of cotton cultivation and processing a total of 1500 gallons of water are consumed.

2. In addition, (Annapoorani, 2017) continued by noting that one pair of Levi's jeans requires approximately 1800 gallons of water from its production to washing stage.

3. According to (K.Amutha, 2017) 's analysis of information, from an American Chemical Society news release from June 18, 2012, the manufacturing of a pair of jeans uses more than 2500 gallons of water (including cotton cultivation, dyeing, and denim processing), as well as nearly a pound of chemicals (in the form of dyes, auxiliaries and finishing agents). If this is multiplied by the number of jeans produced globally, one can have an idea about how the denim industry contributes enormously to water pollution. In addition, from GLASA 2015 State of Apparel sector Special Report Water, she found that during the cotton cultivation and processing 20000 Liter of water is required to manufacture 1 kg of denim fabric and for treating, dyeing and finishing of that fabric requires around 150 liter of water is used.

4. (Periyasamy, Wiener, & Militky, 2017) analysis, using information from Levi Strauss & Co 2015 founds that in a life cycle of a jean, it consumes 2565 liters of water from fiber cultivation to harvesting and 236 liters of water is used for fabric formation. They also continued by noting findings indicate that in denim warp sizing is for almost 100 Liter of water 12.5kg of size ingredients (modified starch 8 kg, acrylate size 4kg, textile wax 0.2Kg) are used. As the size pick-up is in general 9%–10%, the rest of the size paste remains in the bath; it can be washed away during the rinsing process and turns into pollution.

5. (Asmi, Zhang, Anwar, & Linke, 2022) state that Every pair of denim jean manufactured uses 3781 L of water, releases 33.4 kg of carbon dioxide into the atmosphere, and usually takes 12 m^2 of land.

6. (Hossain & Khan, 2020) analyzed the data from PARCL. Approximate Weight of Goods (2017) where the water footprint of pair of a pair of jeans (650 gram) was calculated to be 9506 Liter. The overall water footprint was found to be 3218 L, with respect to green, blue and grey water

footprints 3218 Liter, 2979 Liter and 2781 Liter, ETP and STP were not taken into account when making this computation. Grey water footprint for a pair of jeans is decreased to 2443 L when ETP and STP are taken into account.

7. Cotton denim uses 9870 m^3 of water per ton (5120 m^3 for blue water footprint and 4648 m^3 for green water foot print). The manufacture of cotton fiber accounts for the majority of water footprint (95%), however the production of fabric only required 496 m^3 blue water footprint per ton of denim products. This is according to research by (Zhao, Zhou, & Meng, 2021).

8. An analysis by (Kocabaş & Merve, 2008) shows that in a 100% cotton denim industry the majority of water is consumed in dyeing and finishing processes which subsequently produce the highest amount of wastewater in the denim mill. He estimated that for producing 52,310,712-meter fabric annually 67,769 tons of water is required for sizing, 367,359 for dyeing and for finishing the fabric 453,303 tons of water is consumed.

9. (Zhu, et al., 2022) add on this by noting that Indigo dye, a fundamental dye in the denim industry, uses roughly 30 to 50 tons of water per million meters in the washing process after dyeing in order to remove the floating color.

10. A recent experiment conducted by (Rai, Saremi, Sharma, & Minko, 2021) founds that without estimating the pre and post treatment and washing, only to dye one kilogram of cotton with conventional pure indigo powder 10-75 liter of water is required loaded with toxic reducing agents and alkali that remain effluent in wastewater.

11. To examine the water consumption of traditional indigo dyeing and waterless indigo dyeing (Hoque & Faysal, 2019) founds that in traditional indigo dyeing every wash box requires 75L/min water flow. so, a total of 450 L/min water flow is required in 6 wash boxes while dyeing to remove the caustic soda and other auxiliaries completely from the substrate thorough rinsing in pre-wash boxes and to eliminate the unfix dyes and chemicals in post-wash boxes.

    They also compared the conventional indigo dyeing process with the waterless indigo dyeing and shows that in conventional indigo dyeing to dye 2000-meter fabric total 69800-liter water is

required involving pre-wetting 2600 Liter, pre-wash 21600 liter, dyeing 2400-liter, post wash 21600 liter.

12. (kabir, 2019) analyzed data from Nearchimica: The Sustainability in denim,2019 which gives him an idea about the water consumption in denim washing. He finds that in conventional processing around 100kg denim jeans use 1000-liter water in desizing, 2000-4000 liter in rinsing, 1000 liters in stone washing, 7000-9000 liter for bleaching which is in total 11000-15000-liter water.

13. (Zhang, et al., 2020) performed an experiment to measure the water consumption of two different denim products for operational stages and discovered that different finishing processes, such as rinsing, required 95 liters (13%) of water, stone washing, 158 liters (21%) of water, bleaching, 228 liters (33%) of water, neutralization and spray, 175 liters (25%) of water, and softening, 60 liters (8%) of water. Thus, it can be shown that the bleaching and post-bleaching neutralization processes had the greatest consumption values. Although a deeper color is obtained visibly, he proposed that a significant quantity of water can be saved by avoiding neutralization and bleaching if clients can be convinced to use it.

CHAPTER–3
EXPERIMENTAL DATA

3.1 Selected Factory

The study was conducted at a company that produces denim fabric. The company was founded in 2016 in Vulta, Rupganj. The production processes were evaluated on location in order for the data collecting steps to be successful. On different yarn counts, different types of dyes, and other factors, detailed data regarding denim water usage was collected. Denim yarn water consumption takes into account all of the water used during the various manufacturing processes. Various manufacturing processes are used from the manufacture of fiber to that of fabric and apparel, including ginning, yarn production, indigo dyeing, weaving, stitching, and final treatment procedures. Because of this, the present study established the upper and lower bounds for water usage estimates, using the company's dyeing-Sizing department as a border. The functional unit was determined to be one kilogram of warp yarn. This study tries to assess water consumption using the most commonly produced yarn counts. An inventory study for operating stages was carried out to evaluate the water consumption of the chosen denim yarn. Every stage of the process took input water into account. Five people were interviewed for this department as a whole, and other production-supporting employees were considered when gathering machine specifications.

3.2 Process Flow Chart of Denim Dyeing Sizing:

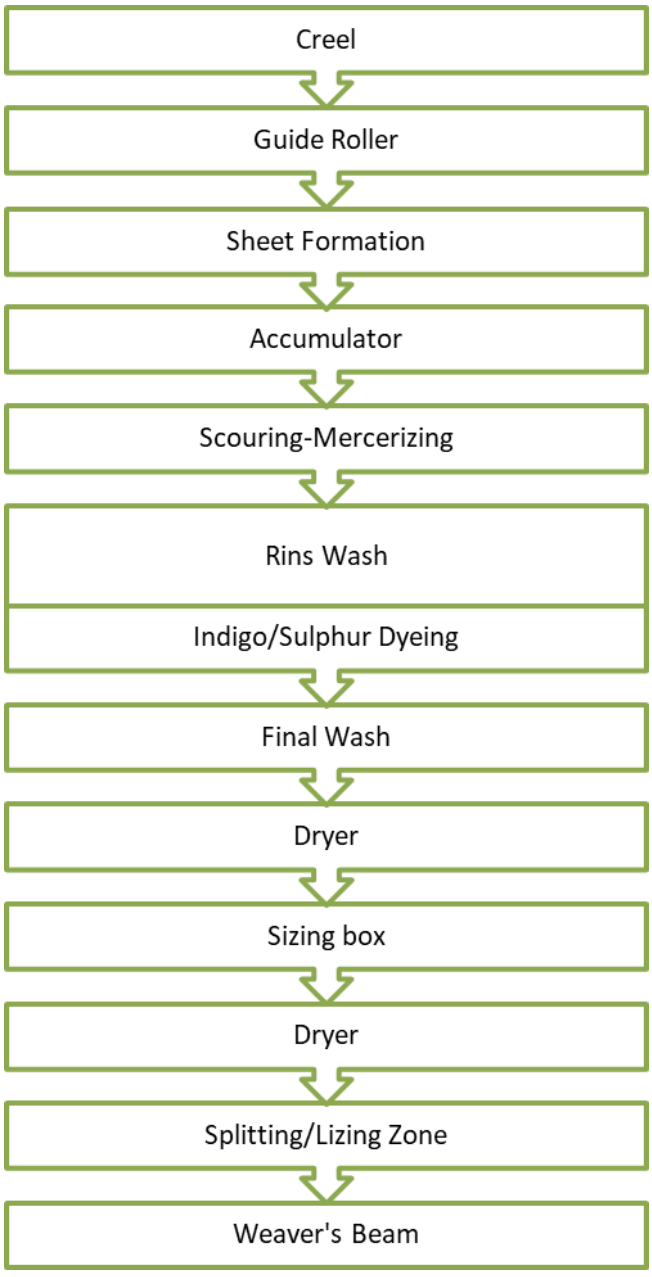
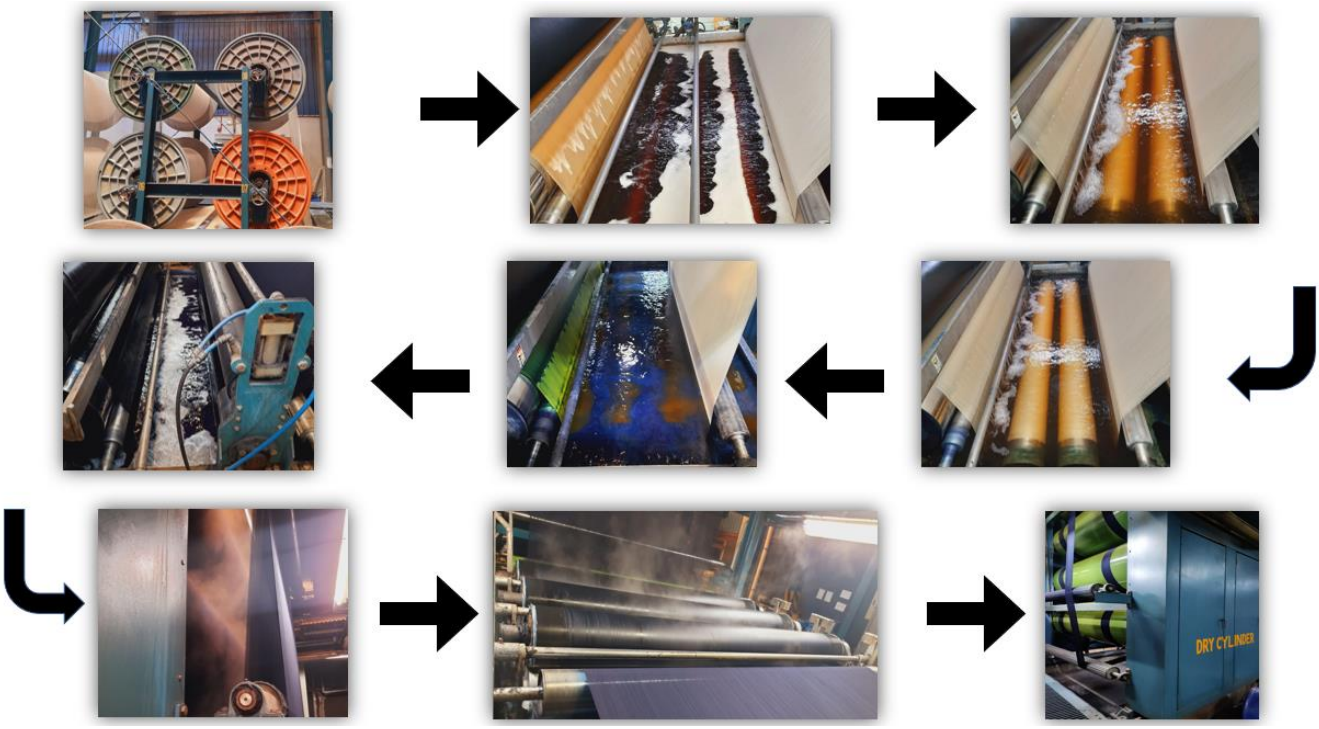


Fig:3.1 Process Flow Chart of Denim Dyeing Sizing

Brief Description:



Creel: The first step in the entire process is the creel, which is a framework or stand that contains numerous spools of yarn or thread. It provides a consistent flow of yarn for the following steps.

A guide roller supports to maintain the right tension and alignment of the yarn as it evolves by passing the yarn from the creel through it.

Sheet Formation: The yarn is then fed into a device where it goes through sheet creation. The yarn is layered and arranged in a certain way during this procedure to produce a flawless textile structure.

Accumulator: The textile material enters an accumulator after sheet creation. Even if there are brief delays or disruptions in the opposite direction, output can continue since the accumulator acts as a temporary storage place.

Scouring-Mercerizing: The textile material is next subjected to a scouring-mercerizing procedure. Mercerizing improves the fabric's strength, shine, and ability to absorb dye, whereas scouring entails eliminating impurities and oils from the fabric.

Rinse Wash: After the scouring-mercerizing stage, the fabric goes through a rinsing wash to get rid of any chemicals or impurities left over from the earlier steps.

Indigo/Sulphur Dyeing: Depending on the desired shade, the fabric is then either indigo or sulfur dyed. While sulfur dyeing yields a variety of shades frequently utilized for denim materials, indigo dyeing yields several shades of blue.

Final Wash: After dyeing, the cloth goes through one last wash to get rid of any extra chemicals, dye, or impurities to make sure that the shade has stabilized and the material itself stays clean.

Dryer: After passing the fabric through a dryer, the moisture from the fabric is drawn out and it is completely dried.

Sizing: The treated fabric then goes into a sizing box. Sizing is the process of covering anything with a protective layer, such starch or another sizing agent, to make it easier to handle and weave.

Dryer: The fabric goes through another dryer after the size procedure to eliminate moisture and dry the sizing agents that were used.

Splitting/Lizing Zone: At this point, the material may split or lize. While lizing includes aligning and straightening the cloth borders, splitting entails cutting a broader fabric into narrower strips.

Weaver's Beam: The finished textile is then wound onto a weaver's beam, which is a sizable cylinder or spool. In doing so, the fabric is made ready to be used in the weaving process, which will further change it into the final textile product.

3.3 Some Yarn Sample Used in Dyeing-Sizing:

Sample 01: 12OE

Sample 02: 10 OE

Sample 03: Blue Black

Sample 04: Pure Black

Sample 05 : 16+70D

Sample 06:
1616+70D(viscose+
Poly)

3.4 Average Monthly Water Consumption of 3 Panon Warp Dyeing Machines:

In order to gain a picture of the factory's sheet dyeing machine's overall water usage, Monthly water use was investigated initially.

For the purposes of comparison, specific water consumption has been considered to be a better indicator to evaluate the effectiveness of the factory's water consumption pattern. This is due to the fact that the particular water consumption accounts for the amount of fabric production as well as the impact of the recipe on overall water consumption. These effects cannot be distinguished in any other case. The phrase "specific water consumption" simply refers to the volume of water used to produce a given quantity of textiles (i.e., the number of liters of water used per kilogram of yarn dyeing).

Month	Total Yarn Wt in 3 M/c(Kg)	Yarn Wt./M' c(Kg)	Water Cons. In M' c-1(m^3)	Water Cons. In M' c-1(L)	Water Cons. In M' c-1(L/Kg)	Water Cons. In M' c-2(m^3)	Water Cons. In M' c-2(L)	Water Cons. In M' c-2(L/Kg)	Water Cons. In M' c-3(m^3)	Water Cons. In M' c-3(L)	Water Cons. In M' c-2(L/Kg)
Jan-22	863502	287834	8844	884400	30.726	10192	10192000	35.409	9922	9922000	34.471
Feb-22	820933	273644.33	7976	7976000	29.147	9754	9754000	35.645	8963	8963000	32.754
Mar-22	1055512	351837.33	9987	9987000	28.385	10747	10747000	30.545	9614	9614000	27.325
Apr-22	974587	324862.33	8855	8855000	27.258	9685	9685000	29.813	9612	9612000	29.587
May-22	777873	259291	7500	7500000	28.925	7792	7792000	30.051	7792	7792000	30.051
Jun-22	586694	195564.67	5450	5450000	27.868	4999	4999000	25.562	4550	4550000	23.267
Jul-22	805868	268622.67	8950	8950000	33.318	7919	7919000	29.48	6982	6982000	25.992
Aug-22	794430	264810	7690	7690000	29.039	12949	12949000	48.899	5861	5861000	22.133
Sep-22	747963	249321	7372	7372000	29.568	11371	11371000	45.608	3531	3531000	14.162
Oct-22	775271	258423.67	7713	7713000	29.846	13848	13848000	53.586	3415	3415000	13.214
Nov-22	717319	239106.33	6675	6675000	27.916	`0636	10636000	44.482	4099	4099000	17.143
Dec-22	785297	261765.67	7446	7446000	28.445	11558	11558000	44.154	5213	5213000	24.168
Avg					37.77			24.17			29.20

Table:3.1 Monthly Water Consumption Report from the Month Jan,2022 to Dec 20222 for 3 machines.

Machine-1	
Brand	Panon
Manufacturer	Panon Industrial CO. Ltd.
Origin	Taiwan
Year	2016.08
Reserve Tank	1000L
Beam Width	1800mm

Machine-2	
Brand	Panon
Manufacturer	Panon Industrial CO. Ltd.
Origin	Taiwan
Year	2018.10
Reserve Tank	1300L
Beam Width	2100mm

Machine-3	
Brand	Panon
Manufacturer	Panon Industrial CO. Ltd.
Origin	Taiwan
Year	2018.10
Reserve Tank	1450L
Beam Width	2100mm

Table:3.2 Machine Specification of 3 Panon Sheet Dyeing Machine

The table 3.1 provides information on the total yarn weight in three denim dyeing machines and the corresponding water consumption in three different machines for each month from January 2022 to December 2022.

Based on the data, the following observations can be made:

Yarn Weight: The total yarn weight in the three manufacturing centers varies each month, ranging from a low of 586,694 kg in June 2022 to a high of 1,055,512 kg in March 2022. The average monthly yarn weight is 836,400 kg, with a standard deviation of 157,747 kg.

Water Consumption: The water consumption in the three water pans also varies each month. Panon-1 consistently uses the least amount of water, with an average of 8,111 m^3 (or 8,111,000 L) consumed per month. Panon-3 consistently uses the most amount of water, with an average of 6,328 m^3 (or 6,328,000 L) consumed per month. Panon-2 falls in between, with an average of 9,918 m^3 (or 9,918,000 L) consumed per month.

Water Consumption per Kg of Yarn: The water consumption per kg of yarn is highest in Panon-2, with an average of 34.3 L/kg, followed by Panon-3 with an average of 28.9 L/kg, and Panon-1 with an average of 28.1 L/kg.

3.5 Reference wise Water Consumption of Panon Warp Dyeing Machine:

Due to average estimation, the results for yarn dyeing and water consumption are nearly identical, as shown in Table 3.1. Therefore, this fact is taken into account by applying specific water consumption data while measuring the water consumption performance of the operations. It is essential to perform a thorough water consumption analysis for each yarn count and dye used because water consumption is influenced by the kind of production, fiber type, yarn count, and dying recipe.

3.5.1WATER CONSUMPTION OF OPEN ENDS YARN IN DENIM MANUFACTURING:

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYE BATH PARAMETER

DYEING DEPARTMENT

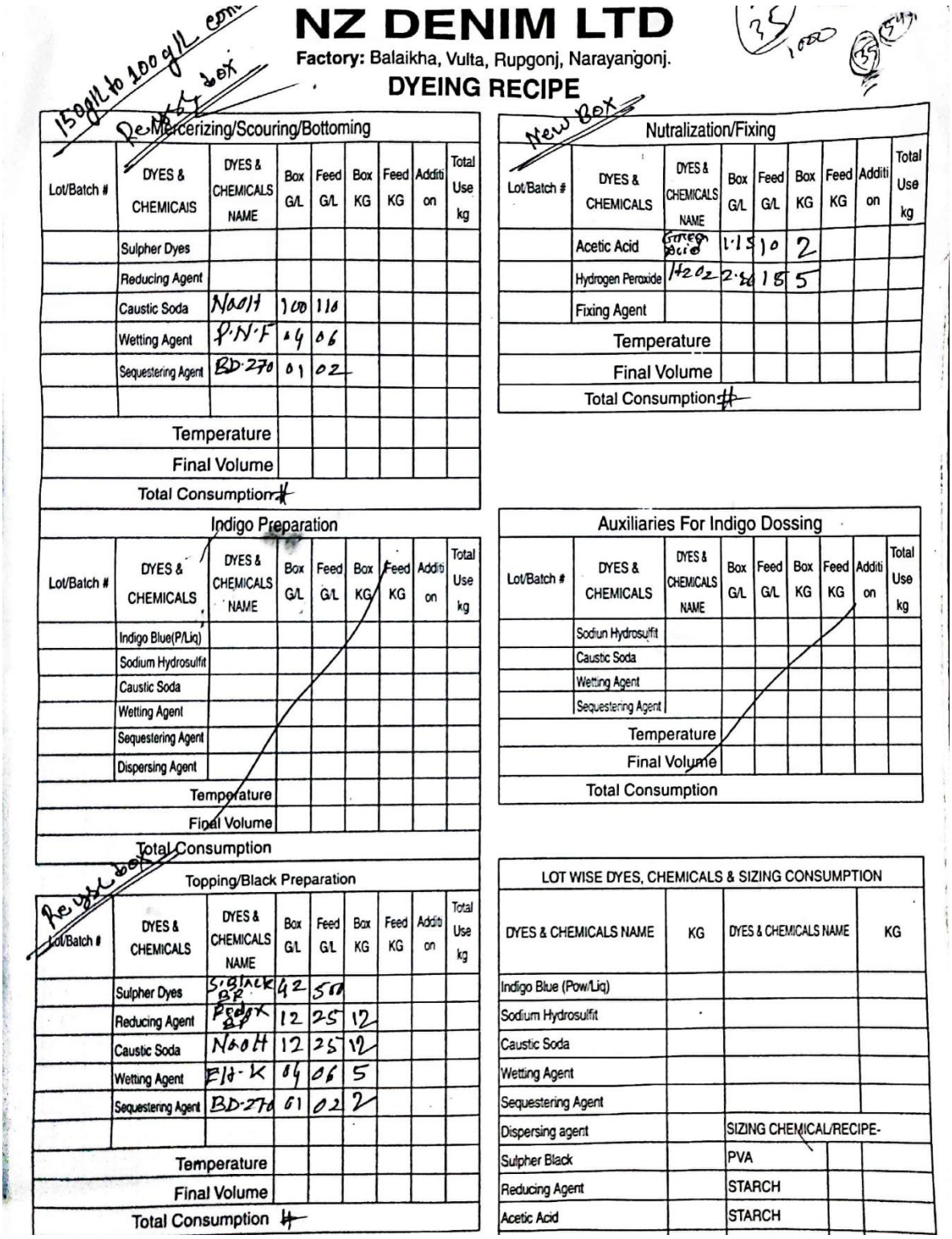
Marketing Person :

NZ CODE	4973-2	P.I. #	6801 R1
PROGRAM NO	7951 (E-2)	DATE	20.05.2023
LOT NO	11487	BUYER	MRP
W. LENGTH	10900 ft	Y-BRAND	NZTEX 137 BT
COUNT	10°E	COLOUR	S. BLACK
T. ENDS	(57/0) 5670	SHADE%	Ind-X Top- 22%
ENDS/BALL	(476X10)+(475X2)=12	INDIGO DIP	X
CONSTRUCTION	66X51/10°EX2 CO+70D(B)144/F	TOPP DIP	02 Dips (07 & 08)
DESIGN	3/1 RHT	INDIGO DOZZING	X
YARN WEIGHT/MTS	337.28gm/mtr	TOPP DOZZING	620 ml/10-05sec (5 CO 02)
MATCH WITH PROG	Master Copy & Lot- 8166/02	HYDRO FEED	X
SPEED	25 mtr/min.	Weave Reed	33/4
MC START TIME	10:35 am	MC STOP TIME	

Descrip.	RR-01	PR-02	WA-01	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	WA-02	WA-03	WA-04	Remarks
Dye Route	Me	W	W	–	–	–		–	–	Black	Black	.	–	–	W	NA	W	
Sq. Pressure	4.5	4.5	4.5	–	By Pass				–	4.5	4.5	–	By Pass		4.5	4.5	4.5	
Temperature	R/T	40°	R/T	–	–	–	–	–	–	85°	85°	–	–	–	40°	45°	50°	

Check Time	PW/ Bott Temp.	Bott g/l	Bott Redox	Bott pH	Be+	Ind Density	Ind g/l	Ind Mv	Ind PH	Ind Dossing	Hydro Dossing	Top Temp.	Top g/l	Top Dossing	Top PH	Top Redox	Nut/Fix PH	Length mts	Sizing SL	Psi	Remarks
10:35	R/T	100 g/L	cooling									85°	38.16	11.6	12.6	646	3.2				
10:50	"	"										"	38.17	11.6	12.6	643	"				
11:20	"	"										"	38.42	12.0	12.6	642	"				
11:40	"	"										"	38.24	11.9	12.6	641	4.5				
12:20	"	"			R/T Soaping Normal							"	38.16	11.9	12.6	642	"				
12:40	"	"										"	38.17	11.9	12.5	641	"				
1:20	"	"										"	38.26	11.9	12.5	642	"				
1:40	"	"										"	38.42	11.9	12.5	642	"				
2:00	R/T	100	g/L	mercerising								85°	38.82	11.9	12.6	640	4.3				
2:20	"	"										"	38.16	11.9	12.6	641	"				
2:40	"	"										"	38.13	11.7	12.6	640	"				
3:00	"	"										"	38.14	11.7	12.6	639	"				
3:20	"	"										"	38.15	11.2	12.6	638	4.4				
3:40	"	"										"	38.14	11.2	12.6	639	"				
4:00	"	"										"	38.15	11.2	12.6	638	"				
4:20	"	"										"	38.16	11.2	12.6	637	"				
4:40	"	"										"	38.15	11.2	12.6	638	"				
5:00	"	"										"	38.00	10.7	12.6	637	"				
5:20	"	"										"	38.06	10.7	12.6	638	4.5				
5:40	"	"										"	38.10	10.7	12.6	637	"				
6:00	"	"										"	38.13	10.7	12.6	636	"				

Fig:3.2 Open Ends (10 Ne) Yarn Dyeing Report



NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYEING RECIPE

150g/L to 100 g/L conc. Re-Mercerizing/Scouring/Bottoming

Lot/Batch #	DYES & CHEMICAIS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes							
	Reducing Agent							
	Caustic Soda	NaOH	100	116				
	Wetting Agent	P.N.F	04	06				
	Sequestering Agent	BD-270	01	02				
	Temperature							
	Final Volume							
	Total Consumption							

New Box

Nutralization/Fixing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Acetic Acid	Glacial acid	1.5	10	2			
	Hydrogen Peroxide	H_2O_2	2.5	15	5			
	Fixing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Indigo Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Indigo Blue(P/Liq)							
	Sodium Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Dispersing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Auxiliaries For Indigo Dossing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sodiun Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Re use box

Topping/Black Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes	Sulblack BR	42	50				
	Reducing Agent	Redox BF	12	25	12			
	Caustic Soda	NaOH	12	25	12			
	Wetting Agent	F/B-K	04	06	5			
	Sequestering Agent	BD-270	01	02	2			
	Temperature							
	Final Volume							
	Total Consumption							

LOT WISE DYES, CHEMICALS & SIZING CONSUMPTION

DYES & CHEMICALS NAME	KG	DYES & CHEMICALS NAME	KG
Indigo Blue (Pow/Liq)			
Sodium Hydrosulfit			
Caustic Soda			
Wetting Agent			
Sequestering Agent			
Dispersing agent		SIZING CHEMICAL/RECIPE-	
Sulpher Black		PVA	
Reducing Agent		STARCH	
Acetic Acid		STARCH	

Fig:3.3 Open Ends (10 Ne) Yarn Dyeing Recipe

302

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYE BATH PARAMETER

DYEING DEPARTMENT

Marketing Person : Ali mamun

NZ CODE	8354 OD	P.I. #	6805
PROGRAM NO	7960 (E-1)	DATE	28/05/23
LOT NO	11545	BUYER	GU.mens
W. LENGTH	18750 mtrs	Y-BRAND	OW man (OOOD)
COUNT	90E	COLOUR	S.Black + Black OD
T. ENDS	5160	SHADE%	Ind- Top- 2.5%
ENDS/BALL	516 X 10	INDIGO DIP	
CONSTRUCTION		TOPP DIP	02 DIPS (09.10)
DESIGN	2/1 RHT	INDIGO DOZZING	
YARN WEIGHT/MTS	0.3386 Kg/mtr	TOPP DOZZING	520 ml/11.16 Sec
MATCH WITH PROG	PO/5604 . Lot: 8430	HYDRO FEED	
SPEED	25 m/min	Weave Reed	46/3
MC START TIME	01:30 Am	MC STOP TIME	

Descrip.	RR-01	PR-02	WA-01	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	WA-02	WA-03	WA-04	Remarks
Dye Route	MER	–	W	W								Black	Black	–	W	NU	W	
Sq. Pressure	4.5	–	4.5	4.5			By	pass				4.5	4.5	–	4.5	α	4.5	
Temperature	RT	–	40°C	RT								85°C	85°C	–	40°C	45°C	50°C	

Check Time	PW/ Bott Temp.	Bott g/l	Bott Redox	Bott pH	Be+	Ind Density	Ind g/l	Ind Mv	Ind PH	Ind Dossing	Hydro Dossing	Top Temp.	Top g/l	Top Dossing	Top PH	Top Redox	Nut/Fix PH	Length mts	Sizing SL	Psi	Remarks
1:30	RT	100/12			Baume		11.5					85	54.2	11.1	12.5	631	3.0				
2:00												"	52.2	11.100	12.5	630					
2:30	"	"										85	52.5	11.10	12.52	630	3.9				
3:00												"	51.9	11.10	12.5	630					
3:30	"	"										85	52.0	11.70	12.5	630	4.5		01		957
4:00					50 lb							"	52.0	1170	12.5	626					
4:30	"	"			+							85	52.0	11.70	12.45	626	5.2				
5:00					Kausar							"	51.7	11.85	12.45	621			02		835
5:30	"	"											52.2	11.85	12.45	622	6.0				
6:10	"	"										85	53.4	11.95	12.52	620	6.2				
6:40	"	"										"	54.3	12.10	12.55	622	6.1		3		1002
7:10	"	"										"	54.6	12.10	12.56	623	6.0				
7:40	"	"										"	55.1	12.10	12.55	620	6.1				
8:10	"	"										"	54.6	12.10	12.57	626	6.2		4		992
8:40	"	"										"	54.3	12.10	12.58	624	6.1				

Fig:3.4 Open Ends (8 Ne) Yarn Dyeing Report

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYEING RECIPE

Mercerizing/Scouring/Bottoming

Lot/Batch #	DYES & CHEMICAIS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes							
	Reducing Agent							
5804-2023	Caustic Soda	NaOH	100	110				
5502013	Wetting Agent	P.N F	04	06				
5050 P77	Sequestering Agent	BD230	05	01				
	Temperature							
	Final Volume							
Re-use Box	Total Consumption							

Nutralization/Fixing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
2207/850	Acetic Acid	Acid	1.15	10	02			
	Hydrogen Peroxide	H_2O_2	2.86	15	05			
	Fixing Agent							
	Temperature							
New Box	Final Volume							
	Total Consumption							

Indigo Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Indigo Blue(P/Liq)							
	Sodium Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Dispersing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Auxiliaries For Indigo Dossing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sodiun Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Topping/Black Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
228810	Sulpher Dyes	Sulphur Black BR	SP 55	750				
20210712	Reducing Agent	BP	12	40				
5804-2023	Caustic Soda	NaOH	12	40				
2206/800	Wetting Agent	EH-K	04	06				
5050 P77	Sequestering Agent	BD-270	0.5	01				
Re-use Box	Temperature							
	Final Volume							
	Total Consumption							

LOT WISE DYES, CHEMICALS & SIZING CONSUMPTION

DYES & CHEMICALS NAME	KG	DYES & CHEMICALS NAME	KG
Indigo Blue (Pow/Liq)			
Sodium Hydrosulfit			
Caustic Soda			
Wetting Agent			
Sequestering Agent			
Dispersing agent		SIZING CHEMICAL/RECIPE-	
Sulpher Black		PVA	
Reducing Agent		STARCH	
Acetic Acid		STARCH	

Fig:3.5 Open Ends (8 Ne) Yarn Dyeing Recipe

3.5.1.1 WATER CONSUMPTION OF OPEN ENDS YARN FOR INDIGO DYEING IN DENIM MANUFACTURING

M/c Name	M/c Speed (m/Min)	Count	Warp length (m)	Total Ends	Yarn Weight (kg/m)	Water consumption (m^3/h)	Water consumption (L/m)	Water consumption (L/kg)	Color	No of wash box
Panon Warp dyeing Machine-2	25	7 OE	13500	4930	0.42	20.46	1.515	3.643	indigo	5
Panon Warp dyeing Machine-2	25	9 OE	22000	4930	0.323	29.38	1.335	4.128	indigo	5
Panon Warp dyeing Machine-2	25	10 OE	5200	4930	0.291	14.45	2.778	9.536	indigo	5
Panon Warp dyeing Machine-2	25	10 OE	21800	5676	0.335	25.08	1.150	3.432	Dark indigo	5

Table:3.3 Water Consumption of Open Ends Yarn for Indigo Dyeing

The table 3.3 provides information related to the production process of a particular type of fabric using a warp dyeing machine. The chart lists several parameters associated with the production process, such as machine speed, count, warp length, total ends, yarn weight, water consumption, color, and number of wash boxes. Let's discuss each parameter in details:

Machine Speed: The machine speed is listed in meters per minute (m/min) and is set to 25 for all the processes. It is an important parameter that determines the productivity of the machine and the rate at which the fabric is produced.

Count: The count of the yarn used in the production process is listed as OE (Open End) and is set to 7, 9, and 10 for the different processes. The count is a measure of the fineness of the yarn and is usually denoted in units of Tex or Ne.

Warp Length: The warp length is listed in meters (m) and is set to 13,500, 22,000, and 5,200 for the different processes. It is a measure of the length of the yarn used for the warp (lengthwise) direction of the fabric.

Total Ends: The total number of warp ends used in the production process is listed in the chart and is set to 4,930 and 5,676 for the different processes. The ends refer to the individual strands of yarn that are arranged lengthwise in the fabric.

Yarn Weight: The yarn weight is listed in kilograms per meter (kg/m) and is set to 0.42, 0.323, and 0.291 for the different processes. It is a measure of the weight of the yarn used in the production process.

Water Consumption: The water consumption is listed in cubic meters per hour (m3/h), liters per meter (L/m), and liters per kilogram (L/kg) and is set to different values for the different processes. The water consumption is an important parameter as it determines the amount of water used in the dyeing process, which in turn affects the environmental impact of the production process.

Color: The color of the fabric produced is listed in the chart and is set to Indigo and Dark Indigo for the different processes. It is an important parameter as it determines the appearance of the fabric and its suitability for different applications.

Number of Wash Boxes: The number of wash boxes used in the production process is listed in the chart and is set to 5 for all the processes. The wash boxes are used to rinse the fabric and remove any excess dye and other impurities.

So, we can say the data chart 3.3 gives a detailed overview of the different parameters involved in the production process of a particular type of fabric using a warp dyeing machine. The data can be used to optimize the production process and improve the efficiency and sustainability of the process. The water consumption parameter is of particular importance, from which we can understand how much water is used in the process to manufacture denim fabric.

3.5.1.2 WATER CONSUMPTION OF OPEN ENDS YARN FOR SULPHUR DYEING IN DENIM MANUFACTURING

M/c Name	M/c Speed (m/Min)	Count	Warp length (m)	Total Ends	Yarn Weight (kg/m)	Water consumption (m^3/h)	Water consumption (L/m)	Water consumption (L/kg)	Color	No of wash box
Panon Warp dyeing Machine-3	25	9 OE	19400	5160	0.338	17.25	0.889	2.626	Sul. B+ Black OD	4
Panon Warp dyeing Machine-2	25	10 OE	21900	6230	0.367	21.22	0.968	2.633	Ash grey	4
Panon Warp dyeing Machine-2	25-28	10 OE	11900	6750	0.398	6.73	0.565	1.418	Ecru	0
Panon Warp dyeing Machine-3	25	10 OE (BCI)	15200	4930	0.291	15.27	1.004	3.449	Black Bottoming	5
Panon Warp dyeing Machine-3	25	10 OE	12600	4930	0.291	12.95	1.027	3.530	Black Bottoming	5
Panon Warp dyeing Machine-3	25	10 OE	3750	5676	0.335	10.52	2.805	8.369	Sulphur Black	4
Panon Warp dyeing Machine-1	25	12 OE	20150	5270	0.253	16.73	0.830	3.201	Black Sandwich	4

Table:3.4 Water Consumption of Open Ends Yarn for Sulphur Dyeing

The table 3.4 presents the production data of three machines in a dyeing company. The machines are Panon Warp Dyeing Machine-2 and Machine-3, and they are producing dyed fabrics using open-end (OE) yarns. The data shows the speed of each machine, the count of the yarn used, the length of the warp, the total number of ends, the weight of yarn used per kilogram of fabric, the water consumption per hour, the water consumption per meter of fabric, the water consumption per kilogram of fabric, the color of the dyed fabric, and the number of wash boxes used.

Upon analyzing the data, it can be observed that Machine-3 produces dyed fabric at a speed of 25 m/min, with a warp length of 19400 m, and a total of 5160 ends. The weight of yarn used per kilogram of fabric is 0.338 kg/m, and the water consumption is 17.25 m^3/h, 0.889 L/m, and 2.626 L/kg. The fabric color is Sulphur Black, and it requires four wash boxes.

Machine-2 also produces fabric at a speed of 25 m/min but has a higher warp length of 21900 m and a total of 6230 ends. The weight of yarn used per kilogram of fabric is 0.367 kg/m, and the water consumption is 21.22 m/h, 0.968 L/m, and 2.633 L/kg. The fabric color is Ash Grey, and it requires four wash boxes.

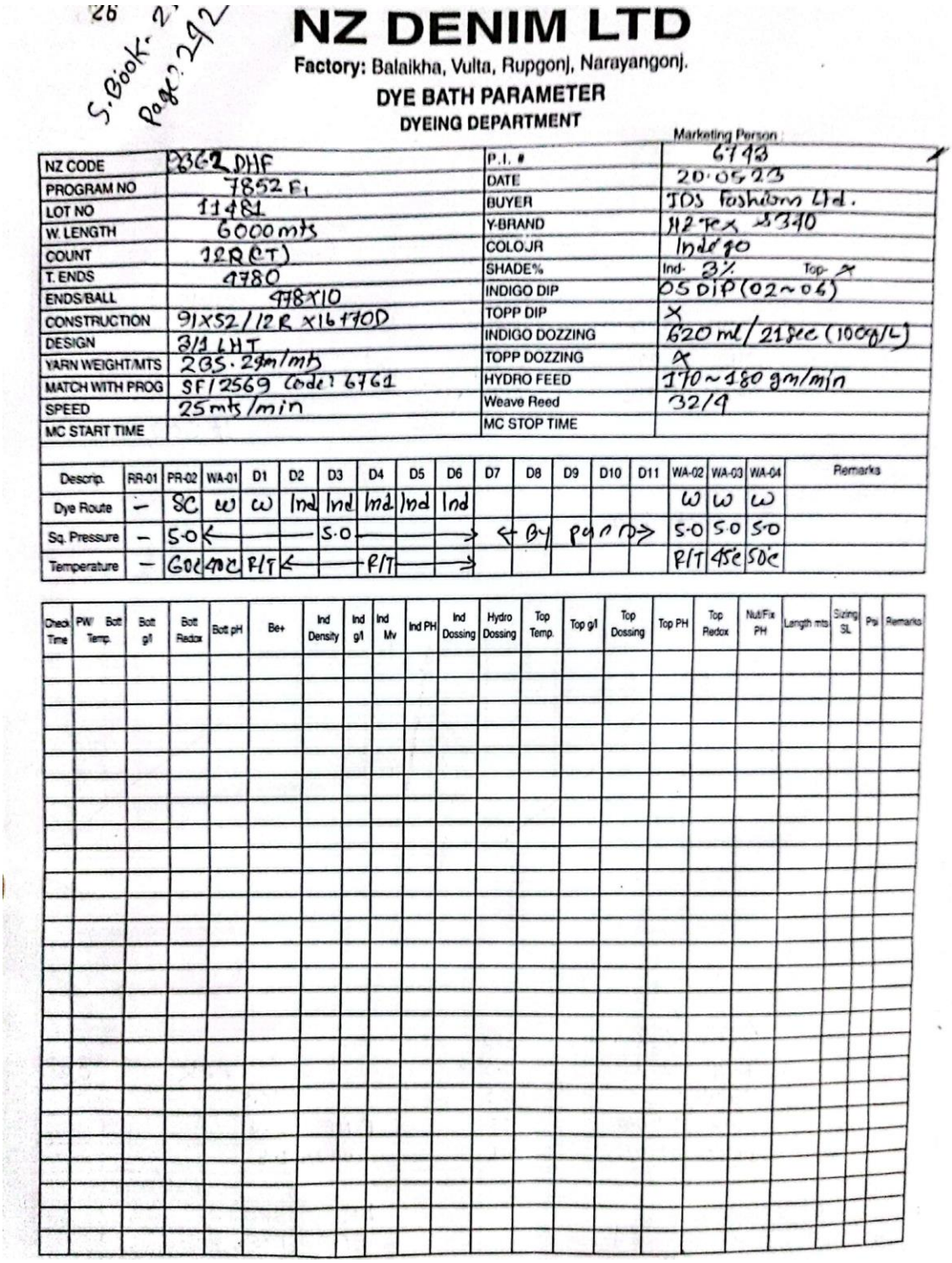
Machine-2 and Machine-3 both use OE yarns with a count of 10. However, Machine-2 produces more fabric than Machine-3, with a shorter warp length per unit. The weight of yarn used per kilogram of fabric is also higher in Machine-2 than in Machine-3, indicating a higher yarn density.

Machine-3 produces dyed fabric using BCI-certified OE yarn with a lower count of 10, which requires less water consumption per kilogram of fabric. The fabric color is Black Bottoming and requires five wash boxes.

The data for the third machine indicates that it has a variable speed of 25-28 m/min, a warp length of 11900 m, and a total of 6750 ends. The weight of yarn used per kilogram of fabric is 0.398 kg/m, and the water consumption is 6.73 m/h, 0.565 L/m, and 1.418 L/kg. The fabric color is Ecru, and it does not require any wash boxes.

In conclusion, the data shows that the production output of each machine varies, with different yarn counts, warp lengths, and fabric colors. The amount of water consumption per kilogram of fabric varies depending on the yarn count and fabric color. Machine-3 produces the lowest water consumption per kilogram of fabric due to its use of BCI-certified OE yarn with a lower count. The data can be used to optimize the production process by adjusting the yarn count, speed, and water consumption.

3.5.2 WATER CONSUMPTION OF RING YARN IN DENIM MANUFACTURING:



NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYE BATH PARAMETER

DYEING DEPARTMENT

S.Book-2 Page: 292

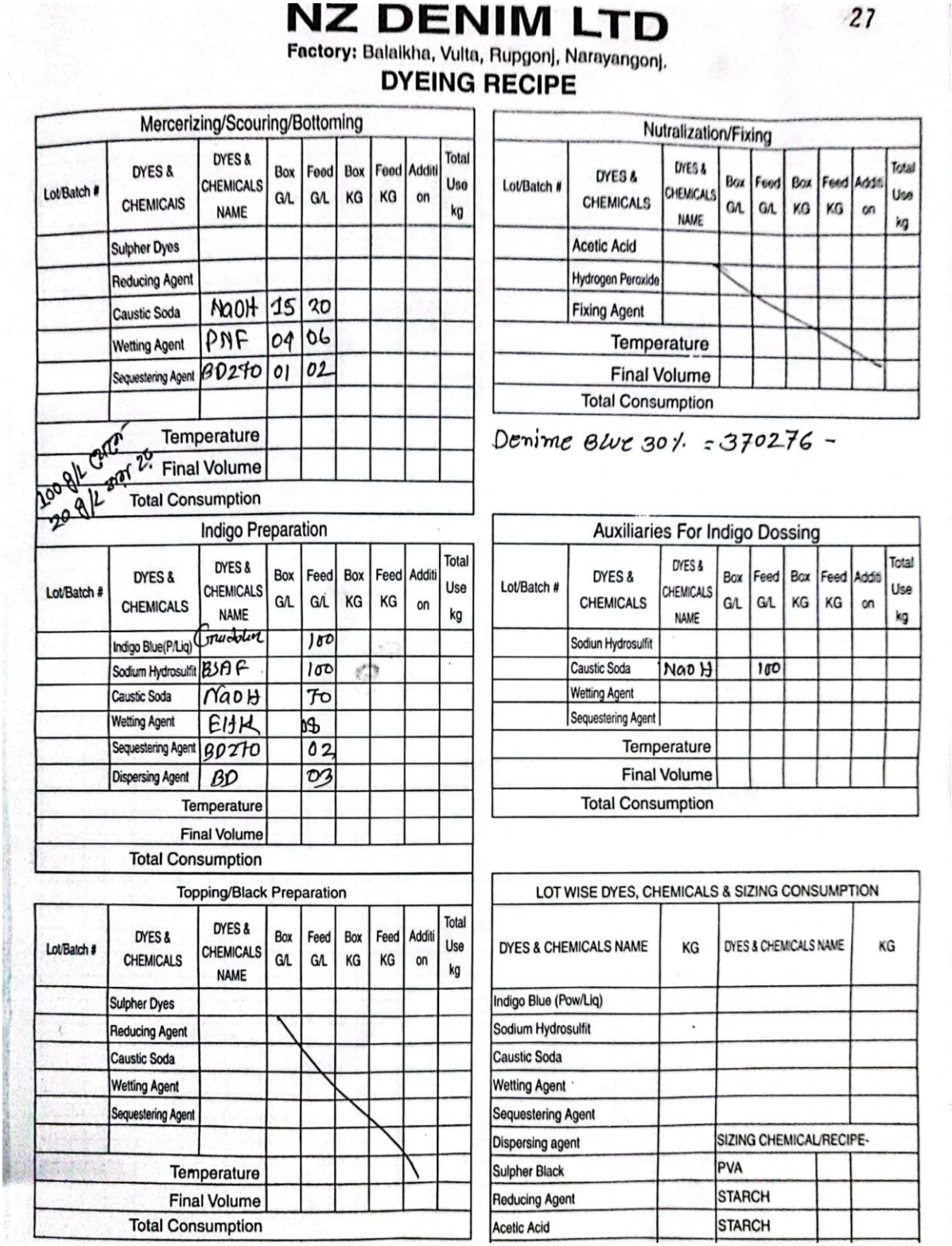
Marketing Person:

NZ CODE	2362 DHF	P.I. #	6743
PROGRAM NO	7852 E1	DATE	20.05.23
LOT NO	11481	BUYER	IDS Fashions Ltd.
W. LENGTH	6000 mts	Y-BRAND	12 Tex 5340
COUNT	12R(CT)	COLOJR	Indigo
T. ENDS	4780	SHADE%	Ind- 3% Top- X
ENDS/BALL	478X10	INDIGO DIP	05 DIP (02~04)
CONSTRUCTION	91X52/12R X164"D	TOPP DIP	X
DESIGN	3/1 LHT	INDIGO DOZZING	620 ml/21sec (100g/L)
YARN WEIGHT/MTS	235.24m/mts	TOPP DOZZING	X
MATCH WITH PROG	SF/2569 Code: 6761	HYDRO FEED	170~180 gm/min
SPEED	25mts/min	Weave Reed	32/9
MC START TIME		MC STOP TIME	

Descrip.	RR-01	PR-02	WA-01	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	WA-02	WA-03	WA-04	Remarks
Dye Route	–	SC	W	W	Ind	Ind	Ind	Ind	Ind						W	W	W	
Sq. Pressure	–	5.0	←	—	—	5.0	—	—	→	← By pump →					5.0	5.0	5.0	
Temperature	–	60C	40C	R/T	←	—	R/T	—	→						R/T	45C	50C	

Check Time	PW/ Bott Temp.	Bott g/l	Bott Redox	Bott pH	Be+	Ind Density	Ind g/l	Ind Mv	Ind PH	Ind Dossing	Hydro Dossing	Top Temp.	Top g/l	Top Dossing	Top PH	Top Redox	Nut/Fix PH	Length mts	Sizing SL	Psi	Remarks

Fig:3.6 Ring Yarn (12 Ne) Dyeing Report



NZ DENIM LTD

27

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYEING RECIPE

Mercerizing/Scouring/Bottoming

Lot/Batch #	DYES & CHEMICAIS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes							
	Reducing Agent							
	Caustic Soda	NaOH	15	20				
	Wetting Agent	PNF	04	06				
	Sequestering Agent	BD270	01	02				
	Temperature							
	Final Volume							
	Total Consumption							

100 g/L Caustic
20 g/L soda ash

Nutralization/Fixing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Acetic Acid							
	Hydrogen Peroxide							
	Fixing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Denime Blue 30% = 370276 -

Indigo Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Indigo Blue(P/Liq)	Crucible		100				
	Sodium Hydrosulfit	BSF		100				
	Caustic Soda	NaOH		70				
	Wetting Agent	EHK		05				
	Sequestering Agent	BD270		02				
	Dispersing Agent	BD		03				
	Temperature							
	Final Volume							
	Total Consumption							

Auxiliaries For Indigo Dossing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sodiun Hydrosulfit							
	Caustic Soda	NaOH		100				
	Wetting Agent							
	Sequestering Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Topping/Black Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes							
	Reducing Agent							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Temperature							
	Final Volume							
	Total Consumption							

LOT WISE DYES, CHEMICALS & SIZING CONSUMPTION

DYES & CHEMICALS NAME	KG	DYES & CHEMICALS NAME	KG
Indigo Blue (Pow/Liq)			
Sodium Hydrosulfit			
Caustic Soda			
Wetting Agent			
Sequestering Agent			
Dispersing agent		SIZING CHEMICAL/RECIPE-	
Sulpher Black		PVA	
Reducing Agent		STARCH	
Acetic Acid		STARCH	

Fig:3.7 Ring Yarn (12 Ne) Dyeing Recipe

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYE BATH PARAMETER

DYEING DEPARTMENT

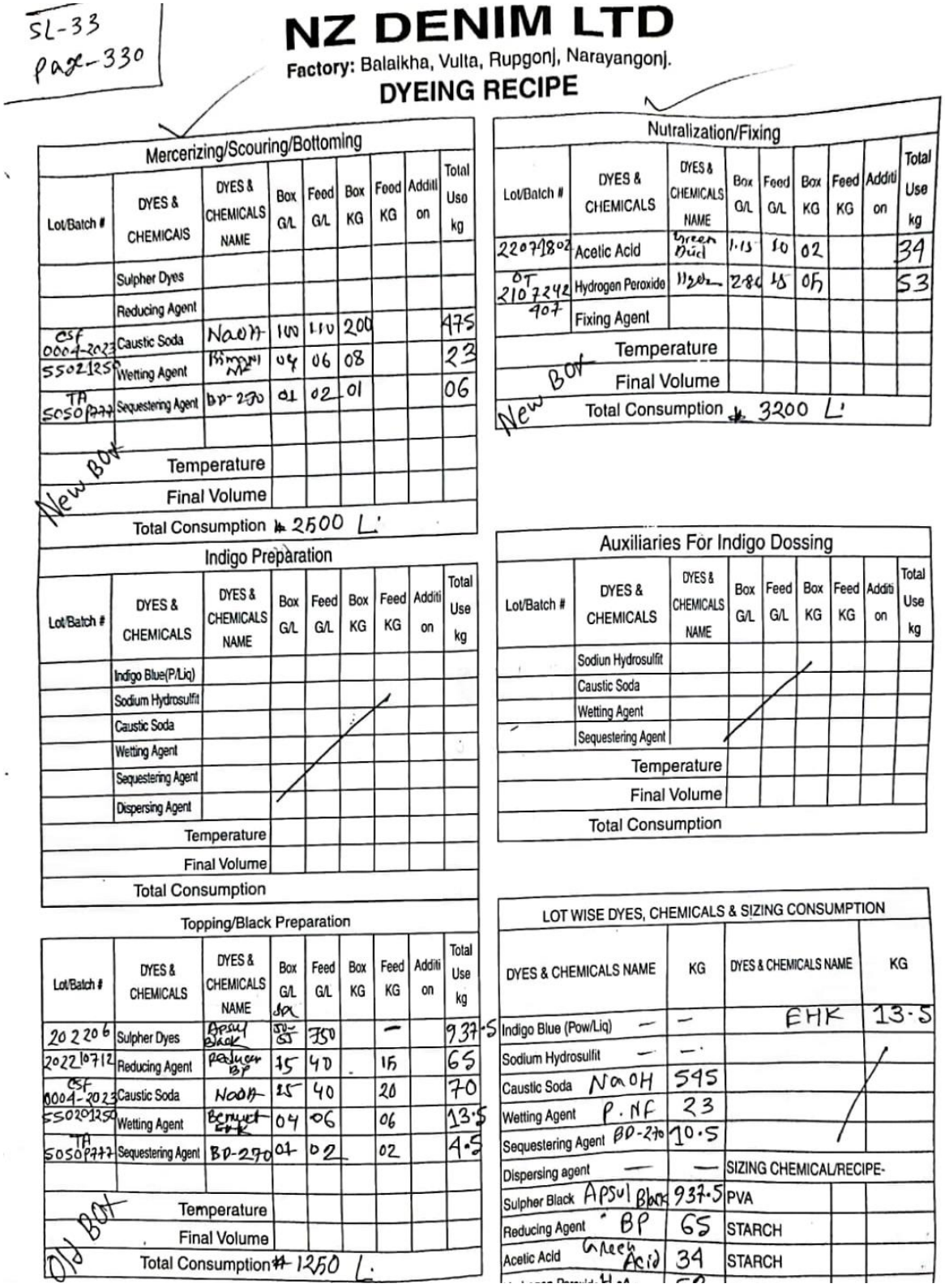
Marketing Person : Mr. Ali Mannon

NZ CODE	NZ-899100	P.I. #	2305132911/6825
PROGRAM NO	R.H 799R(E-1)	DATE	26/05/2023
LOT NO	11521	BUYER	GV Mens
W. LENGTH	16,500 mtrs.	Y-BRAND	NZ Tex 26 BL
COUNT	8R (100%)	COLOUR	5 Black+Black OD
T. ENDS	4480	SHADE%	Ind. Mer-100% L Top-20%
ENDS/BALL	418 X 10	INDIGO DIP	X
CONSTRUCTION	—	TOPP DIP	02 Dips Black (4 Pcs-52~55).
DESIGN	3/1 RHT	INDIGO DOZZING	X
YARN WEIGHT/MTS	308.51449 gm/mtrs. 0.3085 Kg/mtr	TOPP DOZZING	525 ml/15.30 feet 750 ml Approx.
MATCH WITH PROG	SR/3251	HYDRO FEED	X
SPEED	25 mts/mins.	Weave Reed	28/4
MC START TIME	4.10 Am	MC STOP TIME	03.40 pm

Descrip.	RR-01	PR-02	WA-01	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	WA-02	WA-03	WA-04	Remarks
Dye Route	Mer	—	W	W	—	—	—	—	—	—	—	Black	Black	—	W	NW	W	
Sq. Pressure	4J	—	4J	4J	←				By	Pump		4.5	4J	—	4.5	4J	4J	
Temperature	RT	—	40°C	RT	—	—	—	—	—	—	—	85°C	85°C	—	40°C	45°C	50°C	

Check Time	PW/ Bott Temp.	Bott g/l	Bott Redox	Bott pH	Be+	Ind Density	Ind g/l	Ind Mv	Ind PH	Ind Dossing	Hydro Dossing	Top Temp.	Top g/l	Top Dossing	Top PH	Top Redox	Nut/Fix PH	Length mts	Sizing SL	Pis	Remarks
4:10	R/T	100	R/L	M/C	(10.5)							85°C	53.14	15.8	12.72	646	3.1				
9:30	"	"						Rony				"	53.61	15.3	12.70	643	3.4		01		151
5:00	"	"		M/C Speed-25								"	54.46	15.3	12.73	640	4.8				
5:30	"	"						Sojib				"	54.81	15.3	12.70	643	5.8				
6:10	"	"										"	52.6	15.8	12.72	640	6.2				
6:40	"	"										"	52.0	15.8	12.70	639	6.1		02		165
7:10	"	"										"	52.2	15.8	12.68	640	6.2				
7:40	"	"			B/Pilot Sunleeman							"	51.6	16.4	12.69	642	6.1				
8:10	"	"										"	51.4	16.4	12.70	638	6.2		03		50
8:40	"	"										"	51.7	16.4	12.67	637	6.1				
9:10	"	"										"	51.6	16.4	12.69	638	6.2				
9:40	"	"										"	52.0	16.4	12.68	639	6.0		04		80
10:10	"	"										"	52.1	16.4	12.69	640	6.1				
10:40	"	"										"	52.5	16.8	12.65	635	6.1		05		145
11:10	"	"										"	52.2	16.8	12.64	632	6.2				
11:40	"	"										"	52.0	16.8	12.68	635	6.1				
12:10	"	"										"	51.7	16.8	12.66	638	6.0		6		185
12:40	"	"										"	52.2	16.8	12.68	637	6.2				
01:10	"	"										"	52.4	16.8	12.64	635	6.3				
1.40	"	"			M/C Speed-24 mts							"	52.5	16.8	12.65	636	6.2				
02.10	R/T	100	R/L	M/C								85°C	56.8	18.2	12.58	642	5.4				
02:30	"	"		M/C-Speed-25				2021		231		"	55.41	18.2	12.56	638	5.0		07		185
02:30	"	"										"	55.21	18.2	12.58	636	6.1				
03:00	"	"										"	55.71	18.2	12.56	636	6.0		08		41

Fig:3.8 Ring Yarn (8 Ne) Dyeing Report



SL-33
page-330

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYEING RECIPE

Mercerizing/Scouring/Bottoming

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Uso kg
	Sulpher Dyes							
	Reducing Agent							
CSF 0004-2023	Caustic Soda	NaOH	100	110	200			475
5502125	Wetting Agent	Nimon NZ	04	06	08			23
TA 5050P777	Sequestering Agent	BD-250	01	02	01			06
New BOT	Temperature							
	Final Volume							
	Total Consumption = 2500 L							

Nutralization/Fixing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
2207180	Acetic Acid	Green Acid	1.15	10	02			34
OT 2107242 407	Hydrogen Peroxide	H2O2	280	15	05			53
	Fixing Agent							
	Temperature							
New BOT	Final Volume							
	Total Consumption = 3200 L							

Indigo Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Indigo Blue(P/Liq)							
	Sodium Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Dispersing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Auxiliaries For Indigo Dossing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sodiun Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Topping/Black Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
202206	Sulpher Dyes	Apsul Black	50	750		—		937.5
20221012	Reducing Agent	Reducer BP	15	40		15		65
CSF 0004-2023	Caustic Soda	NaOH	25	40		20		70
5502012	Wetting Agent	Bernet EBK	04	06		06		13.5
TA 5050P777	Sequestering Agent	BD-270	01	02		02		4.5
Old BOT	Temperature							
	Final Volume							
	Total Consumption = 1250 L							

LOT WISE DYES, CHEMICALS & SIZING CONSUMPTION

DYES & CHEMICALS NAME	KG	DYES & CHEMICALS NAME	KG
Indigo Blue (Pow/Liq)	—	EHK	13.5
Sodium Hydrosulfit	—		
Caustic Soda NaOH	595		
Wetting Agent P.NF	23		
Sequestering Agent BD-270	10.5		
Dispersing agent	—	SIZING CHEMICAL/RECIPE-	
Sulpher Black Apsul Black	937.5	PVA	
Reducing Agent BP	65	STARCH	
Acetic Acid Green Acid	34	STARCH	

Fig:3.9 Ring Yarn (8Ne) Dyeing Recipe

3.5.2.1 WATER CONSUMPTION OF RING YARN FOR SULPHUR DYEING IN DENIM MANUFACTURING

M/c Name	M/c Speed (m/Min)	Count	Warp length (m)	Total Ends	Yarn Weight (kg/m)	Water consumption (m^3/h)	Water consumption (L/m)	Water consumption (L/kg)	Color	No of wash box
Panon Warp dyeing Machine-1	25	7 R	11500	4180	0.353	16.42	1.427	4.048	Epic	5
Panon Warp dyeing Machine-1	25	7 R	25200	4480	0.3778	35.38	1.403	3.715	LF Epic	5
Panon Warp dyeing Machine-3	25	8 R	16500	4180	0.308	19.15	1.161	3.761	Sulphur black+ Black OD	4
Panon Warp dyeing Machine-3	228-30	10 R	4900	4930	0.291	12.47	2.545	8.741	Ecru+ OD	0

Table:3.5 Water Consumption of Ring Yarn for Sulphur Dyeing

The chart 3.5 offers details about different types of warp dyeing machines, as well as important factors related to each machine. The explanation of each column is provided below:

M/c Name: The name or identity of the warp dyeing machine is shown in this column.

The M/c Speed (m/Min): The value of this column represents the machine's speed in meters per minute. This parameter represents the machine's operating speed.

Count: The yarn count used in the dying process is referred to as the count. It stands for the yarn's fineness or thickness.

Warp Length (m): The entire length of the warp yarn measurement. The lengthwise yarn that is coloured is called the warp yarn.

Yarn Weight (kg/m): The yarn's weight is measured in kilograms per square meter. It denotes the thickness or density of the yarn.

Water Consumption (m/h): The water consumption rate of the device is shown in this column in meters per hour. It shows how much water the device consumes in a single hour.

Water Consumption (L/m): The amount of water consumed by the dyeing machine per meter of cloth is indicated by water consumption (L/m).

Water Consumption (L/kg): The amount of water consumed by the dyeing machine per kilogram of cloth weight is indicated by water consumption (L/kg).

Color: The color or mix of colors used to dye the warp yarn is specified in this column.

Number of wash boxes: The number of wash boxes represents the number of wash compartments or stages involved in the washing process after dyeing.

Each of the machine's name, operating speed, yarn count, warp length, total ends, yarn weight, water consumption rates, colors used for dyeing, and the necessary number of wash boxes are all specified for each machine in the chart.

3.5.3 WATER CONSUMPTION OF MIXED YARN IN DENIM MANUFACTURING:

122

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYE BATH PARAMETER

DYEING DEPARTMENT

Marketing Person : Mostafizur Rahman

NZ CODE	5955 ADF	P.I. #	6221
PROGRAM NO	P0-7073 (E-1)	DATE	28/01/2023
LOT NO	10495	BUYER	ZARA
W. LENGTH	500 mtr	Y-BRAND	NZ Tex (478786B)
COUNT	9RS+9OE (50%+50%)	COLOUR	Indigo
T. ENDS	5230	SHADE%	Ind- 4.1% Top- X
ENDS/BALL	(436X6)+(436X6)	INDIGO DIP	06 Dips (D2-D7)
CONSTRUCTION	—	TOPP DIP	X
DESIGN	3/1 RHT	INDIGO DOZZING	379 ml/min (345%)
YARN WEIGHT/MTS	0.3431 Kg/mtr	TOPP DOZZING	X
MATCH WITH PROG	SF/2327	HYDRO FEED	250 gm/min
SPEED	24 mtr/min	Weave Reed	35/4
MC START TIME	09: AM	MC STOP TIME	09:50 Am.

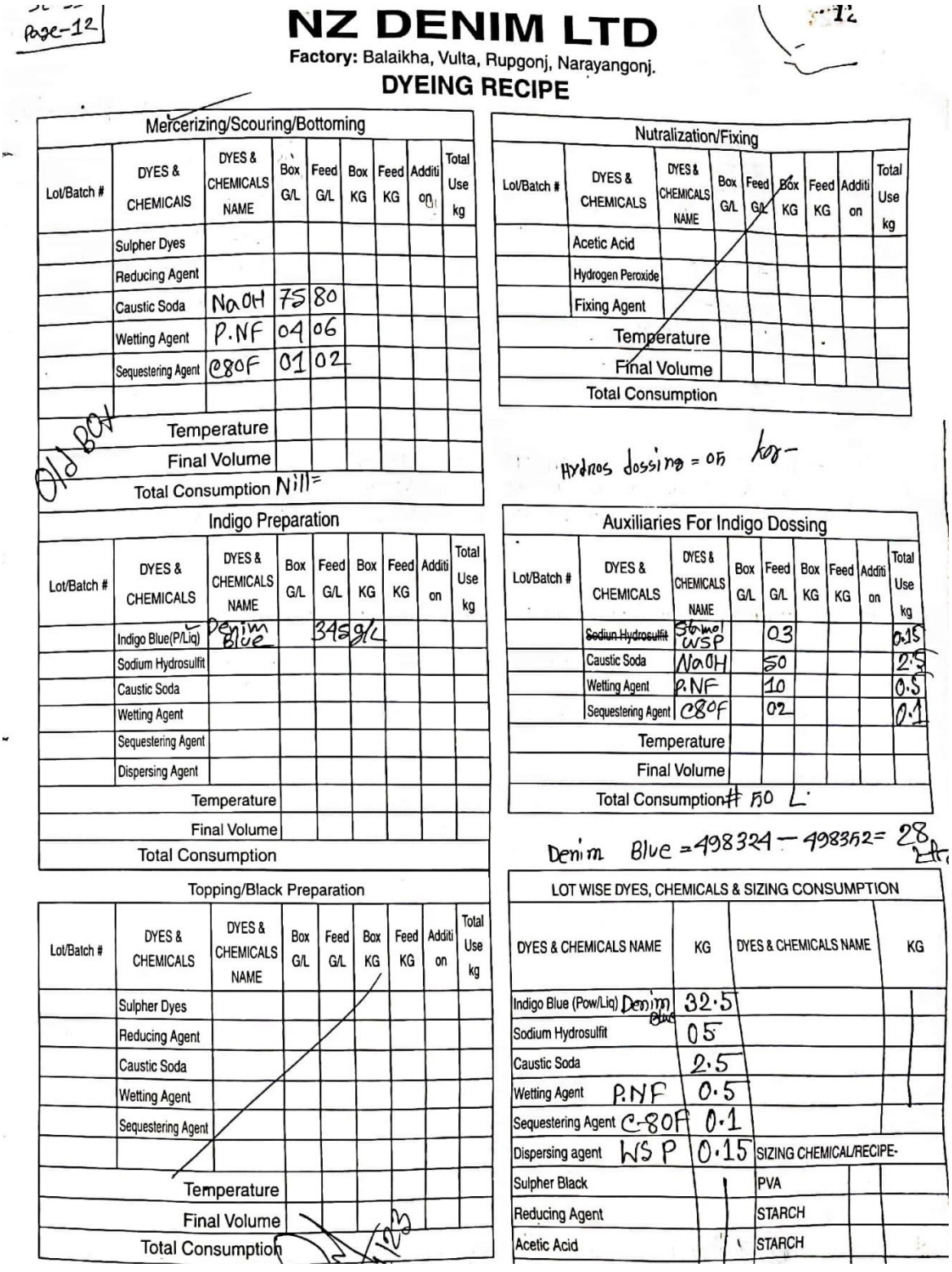
Descrip.	RR-01	PR-02	WA-01	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	WA-02	WA-03	WA-04	Remarks
Dye Route	Men	—	W	W	IND	IND	IND	IND	IND	IND	—	—	—	—	W	W	W	
Sq. Pressure	4.5	-	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	—	—	—	—	4.5	4.5	4.5	
Temperature	RT	-	40°C	RT	RT	RT	RT	RT	RT	RT	—	—	—	—	40°C	45°C	50°C	

Check Time	PW/ Bott Temp.	Bott g/l	Bott Redox	Bott pH	Be+	Ind Density	Ind g/l	Ind Mv	Ind PH	Ind Dossing	Hydro Dossing	Top Temp.	Top g/l	Top Dossing	Top PH	Top Redox	Nut/Fix PH	Length mts	Sizing SL	Psi	Remarks
09:00	RT	75	01	m/n			4.11	765	11.96	995	250										
09:10	11	11					4.08	768	11.98	995	250										
09:35	11	11					4.11	765	11.95	995	250								01		75

Rasel

Soj 1b

Fig:3.10 Mixed Yarn (9Rs+9OE) Dyeing Report



Page-12

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYEING RECIPE

Mercerizing/Scouring/Bottoming

Lot/Batch #	DYES & CHEMICAIS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes							
	Reducing Agent							
	Caustic Soda	NaOH	75	80				
	Wetting Agent	P.NF	04	06				
	Sequestering Agent	C80F	01	02				
	Temperature							
	Final Volume							
	Total Consumption Nill=							

Nutralization/Fixing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Acetic Acid							
	Hydrogen Peroxide							
	Fixing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Hydros dossing = 05 kg-

Indigo Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Indigo Blue(P/Liq)	Denim Blue		345g/L				
	Sodium Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Dispersing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Auxiliaries For Indigo Dossing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	~~Sodium Hydrosulfit~~	Stamol WSP		03				0.15
	Caustic Soda	NaOH		50				2.5
	Wetting Agent	P.NF		10				0.5
	Sequestering Agent	C80F		02				0.1
	Temperature							
	Final Volume							
	Total Consumption# 50 L							

Denim Blue = 498324 − 498352 = 28

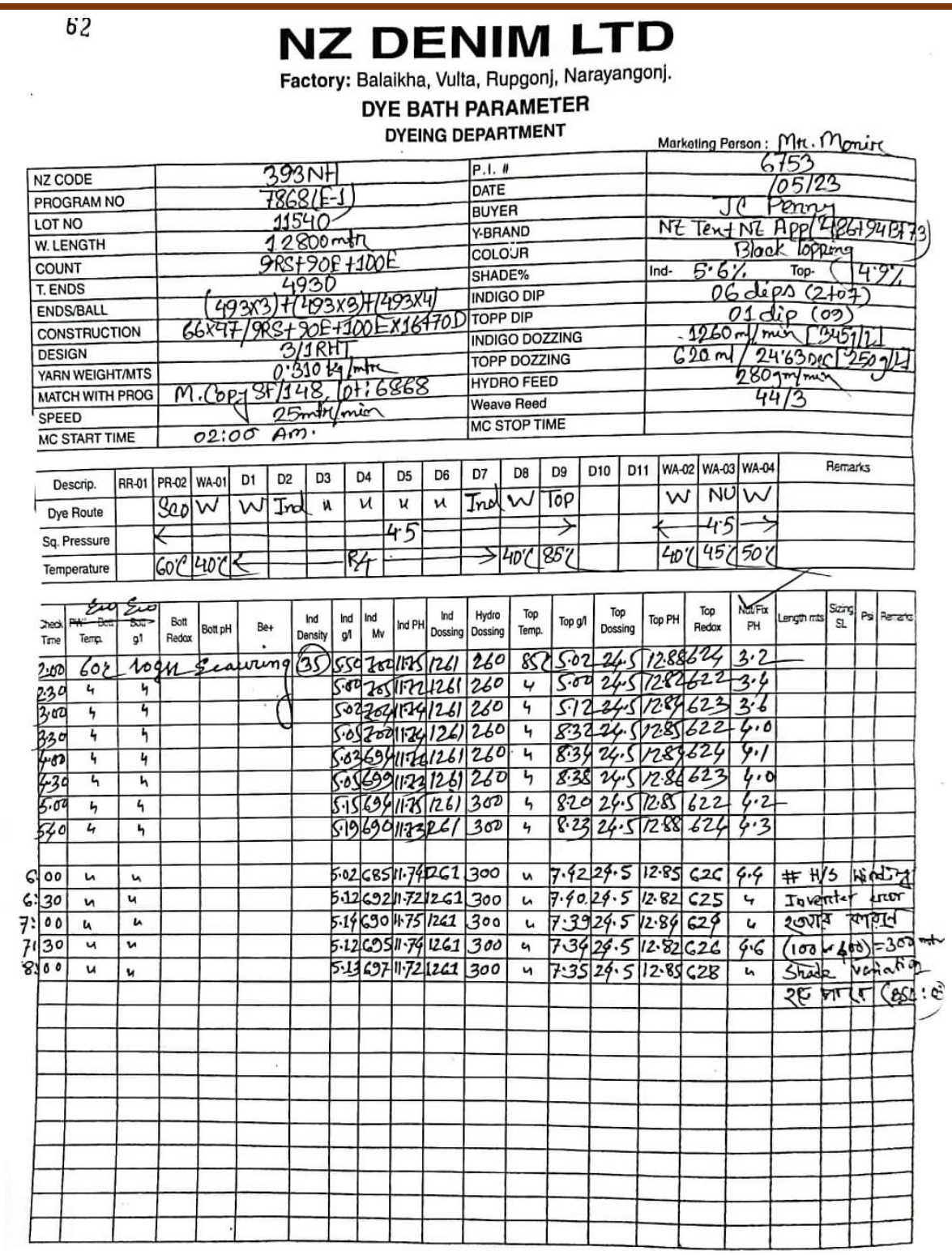
Topping/Black Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes							
	Reducing Agent							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Temperature							
	Final Volume							
	Total Consumption							

LOT WISE DYES, CHEMICALS & SIZING CONSUMPTION

DYES & CHEMICALS NAME	KG	DYES & CHEMICALS NAME	KG
Indigo Blue (Pow/Liq) Denim Blue	32.5		
Sodium Hydrosulfit	05		
Caustic Soda	2.5		
Wetting Agent P.NF	0.5		
Sequestering Agent C-80F	0.1		
Dispersing agent WSP	0.15	SIZING CHEMICAL/RECIPE-	
Sulpher Black		PVA	
Reducing Agent		STARCH	
Acetic Acid		STARCH	

Fig:3.11 Mixed Yarn (9Rs+9OE) Dyeing Recipe



62

NZ DENIM LTD

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYE BATH PARAMETER

DYEING DEPARTMENT

Marketing Person : Mr. Monir

NZ CODE	393NH	P.I. #	6753
PROGRAM NO	7868(E-1)	DATE	05/23
LOT NO	11540	BUYER	JC Penny
W. LENGTH	12800 mtr	Y-BRAND	NT Text NT App (4826194B473)
COUNT	9RS+9OE+10OE	COLOUR	Black topping
T. ENDS	4930	SHADE%	Ind- 5·6% Top- (4·7%
ENDS/BALL	(493x3)+(493x3)+(493x4)	INDIGO DIP	06 dips (2+04)
CONSTRUCTION	66x47/9RS+9OE+10OEx1647OD	TOPP DIP	01 dip (03)
DESIGN	3/1RHT	INDIGO DOZZING	1260 ml/min [345/L]
YARN WEIGHT/MTS	0·310 kg/mtr	TOPP DOZZING	620 ml / 24'63DIC [250 g/L]
MATCH WITH PROG	M.Cop: 9F/148, Of: 6868	HYDRO FEED	280 gm/min
SPEED	25mtr/min	Weave Reed	44/3
MC START TIME	02:00 Am.	MC STOP TIME	

Descrip.	RR-01	PR-02	WA-01	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	WA-02	WA-03	WA-04	Remarks
Dye Route		Soo	W	W	Ind	"	"	"	"	Ind	W	Top			W	NU	W	
Sq. Pressure		←	←	←	←	←	←	4·5	←	←	←	→	→	→	←	4·5	→	
Temperature		60°C	40°C	←	←	←	RT	←	←	→	40°C	85°C			40°C	45°C	50°C	

Check Time	PW Temp.	Bott Temp.	Soo Bott g/l	Bott Redox	Bott pH	Be+	Ind Density	Ind g/l	Ind Mv	Ind PH	Ind Dossing	Hydro Dossing	Top Temp.	Top g/l	Top Dossing	Top PH	Top Redox	Nat/Fix PH	Length mts	Sizing SL	Psi	Remarks
2:00	60	Soo	10gm	Seasoning			(35)	550	700	11.75	1261	260	85	5·02	24·5	12.88	624	3·2				
2:30	"	"						5·00	705	11.72	1261	260	"	5·00	24·5	12.82	622	3·6				
3:00	"	"						5·02	704	11.74	1261	260	"	5·12	24·5	12.84	623	3·6				
3:30	"	"						5·05	702	11.74	1261	260	"	8·32	24·5	12.85	622	4·0				
4:00	"	"						5·03	694	11.74	1261	260	"	8·34	24·5	12.84	624	4·1				
4:30	"	"						5·05	699	11.73	1261	260	"	8·38	24·5	12.84	623	4·0				
5:00	"	"						5·15	694	11.75	1261	300	"	8·20	24·5	12.85	622	4·2				
5:30	"	"						5·19	690	11.73	1261	300	"	8·23	24·5	12.88	624	4·3				
6:00	"	"						5·02	685	11.74	1261	300	"	7·42	24·5	12.85	626	4·4	# H/S Winding			
6:30	"	"						5·12	692	11.72	1261	300	"	7·40	24·5	12.82	625	"	Inverter error			
7:00	"	"						5·14	690	11.75	1261	300	"	7·39	24·5	12.84	624	"	২৩৫৫ কাপান			
7:30	"	"						5·12	695	11.74	1261	300	"	7·34	24·5	12.82	626	4·6	(100+400)=300 mt			
8:00	"	"						5·13	697	11.72	1261	300	"	7·35	24·5	12.85	628	"	Shade variation			
																			২৫ বার (৪৫ : ৫			

Fig:3.12 Mixed Yarn (9Rs+9OE+10OE) Dyeing Report

NZ DENIM LTD

b3

Factory: Balaikha, Vulta, Rupgonj, Narayangonj.

DYEING RECIPE

Mercerizing/Scouring/Bottoming

Lot/Batch #	DYES & CHEMICAIS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes							
	Reducing Agent							
	Caustic Soda	NaOH	10	15	18	20		
	Wetting Agent	P. NF	04	06	07	07		
	Sequestering Agent	BD 270	01	02	02	02		
	Temperature							
	Final Volume							
	Total Consumption							

New Box

Nutralization/Fixing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Acetic Acid	Green Acid	1.15	10	02			
	Hydrogen Peroxide	CB	2.88	15	05			
	Fixing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

New Box

Denim Blue 30%. - 373853-

Indigo Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Indigo Blue(P/Liq)	Denim Blue		345	862			
	Sodium Hydrosulfit							
	Caustic Soda							
	Wetting Agent							
	Sequestering Agent							
	Dispersing Agent							
	Temperature							
	Final Volume							
	Total Consumption							

Auxiliaries For Indigo Dossing

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sodiun Hydrosulfit	BD		03	03			
	Caustic Soda	NaOH		50	06			
	Wetting Agent	P. NF		18	08			
	Sequestering Agent	BD270		02	04			
	Temperature							
	Final Volume							
	Total Consumption							

BASF Hydros -

Topping/Black Preparation

Lot/Batch #	DYES & CHEMICALS	DYES & CHEMICALS NAME	Box G/L	Feed G/L	Box KG	Feed KG	Additi on	Total Use kg
	Sulpher Dyes	Black BR	08	250	20		NO	
	Reducing Agent	BP	12	40	4			
	Caustic Soda	NaOH	12	40	4			
	Wetting Agent	EHR	04	06	2			
	Sequesterlng Agent	BD210	01	02	1			
	Temperature							
	Final Volume							
	Total Consumption							

Reuse Box

LOT WISE DYES, CHEMICALS & SIZING CONSUMPTION

DYES & CHEMICALS NAME	KG	DYES & CHEMICALS NAME	KG
Indigo Blue (Pow/Liq)			
Sodium Hydrosulfit			
Caustic Soda			
Wetting Agent			
Sequestering Agent			
Dispersing agent		SIZING CHEMICAL/RECIPE-	
Sulpher Black		PVA	
Reducing Agent		STARCH	
Acetic Acid		STARCH	
Hydrogen Peroxide		BINDER	

Fig:3.13 Mixed Yarn (9Rs+9OE+10OE) Dyeing Recipe

3.5.3.1 WATER CONSUMPTION OF MIXED YARN FOR SULPHUR DYEING IN DENIM MANUFACTURING

M/c Name	M/c Speed (m/Min)	Count	Warp length (m)	Total Ends	Yarn Weight (kg/m)	Water consumption (m^3/h)	Water consumption (L/m)	Water consumption (L/kg)	Color	No of wash box
Panon Warp dyeing Machine-2	22	7 RS+9 OE(2:3)	22000	5540	0.405	24.28	1.103	2.72	Black	5
Panon Warp dyeing Machine-3	25	16RS+16 OE(3:7)	19850	5680	0.209	26.03	1.311	6.254	Black Topping	5
Panon Warp dyeing Machine-3	25	16RS+16R (3:2)	13750	5380	0.195	22.48	1.634	8.358	Black Bottoming	5
Panon Warp dyeing Machine-2	28-30	12RS+10 OE(33:67)	11500	5980	0.319	4.67	0.406	1.270	Ecru	0

Table:3.6 Water Consumption of Mixed Yarn for Sulphur Dyeing

The table 3.6 offers details on various equipment used in the textile industry for warp dyeing procedures. The explanation of each column is provided below:

M/c Name: The name or designation of the warp dyeing machine is listed in this column. They are "Panon Warp dyeing Machine-3" and "Panon Warp dyeing Machine-2."

M/c Speed (m/Min): The machine's speed is shown in this column in meters per minute. It represents the speed at which the fabric is moved through the dyeing apparatus.

Count: The "Count" column details the make-up of the yarn that was used for dying. The yarn types and their corresponding ratios are tabulated. For instance, "16RS+16 OE(3:7)" indicates the use of 16 counts each of ring spun (RS) and open-end (OE) yarn in a 3:7 ratio.

Warp length (m): The length of the warp, or the collection of yarns listed lengthwise in the dyeing machine, is shown in this column in meter scale.

Total Ends: The term "Total Ends" refers to all of the yarn ends used in the warp. It shows how many yarns are being processed by the machine.

Yarn Weight (kg/m): This column lists the yarn's weight in kilograms per meter, or grams per meter. It offers details regarding the thickness or density of the yarn that was employed.

The "Water consumption" column lists the machine's hourly water consumption in milliliters (m/h). Water volume is gauged in cubic meters (m3).

Water consumption (L/m): This column lists the amount of water needed to dye one meter of fabric, expressed in liters per meter. Water consumption is displayed in this table as liters per kilogram of yarn weight. It shows how much water is needed to dye each kilogram of yarn.

Color: The fabric's dyed color is mentioned in the "Color" column. The colors mentioned in the examples given are "Black Topping," "Black Bottoming," and "Ecru."

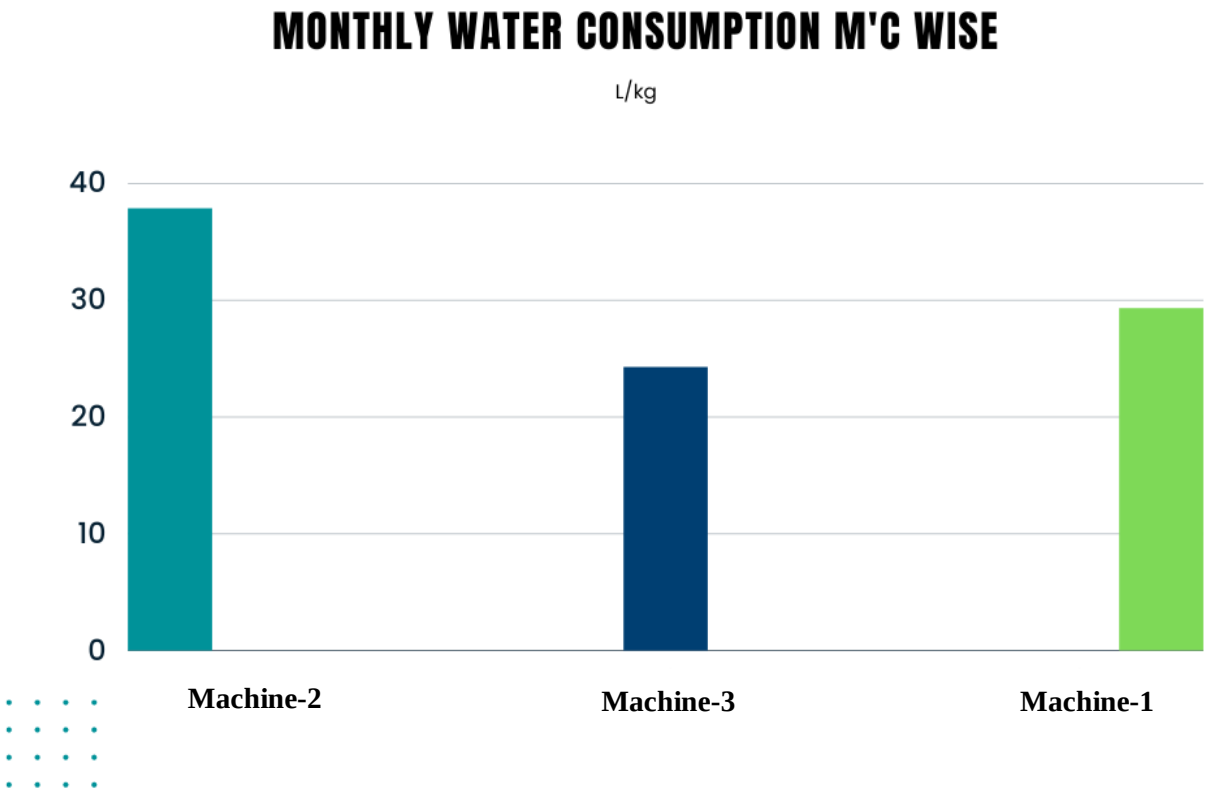
Wash Box: The number of wash boxes used during the dyeing process is shown in this column. In order to get rid of extra dye or impurities, the fabric is washed in wash boxes or other compartments. The amount of washing involved in the process is indicated by the number.

So overall, this chart offers precise information about various warp dyeing machines, including information about their speed, yarn composition, water consumption, and other pertinent factors.

CHAPTER–4

RESULT AND DISCUSSION

4.1 Analysis of Average Monthly Water Consumption of Panon Warp Dyeing Machine



Graph:4.1 Analysis of Monthly Water Consumption of 3 Panon Warp Dyeing Machine

Findings:

In the dyeing-sizing process, there are three separate machines used in the process. The average monthly volume of textiles processed in every machine in the dyeing-sizing line is shown in **Table 3.1**.

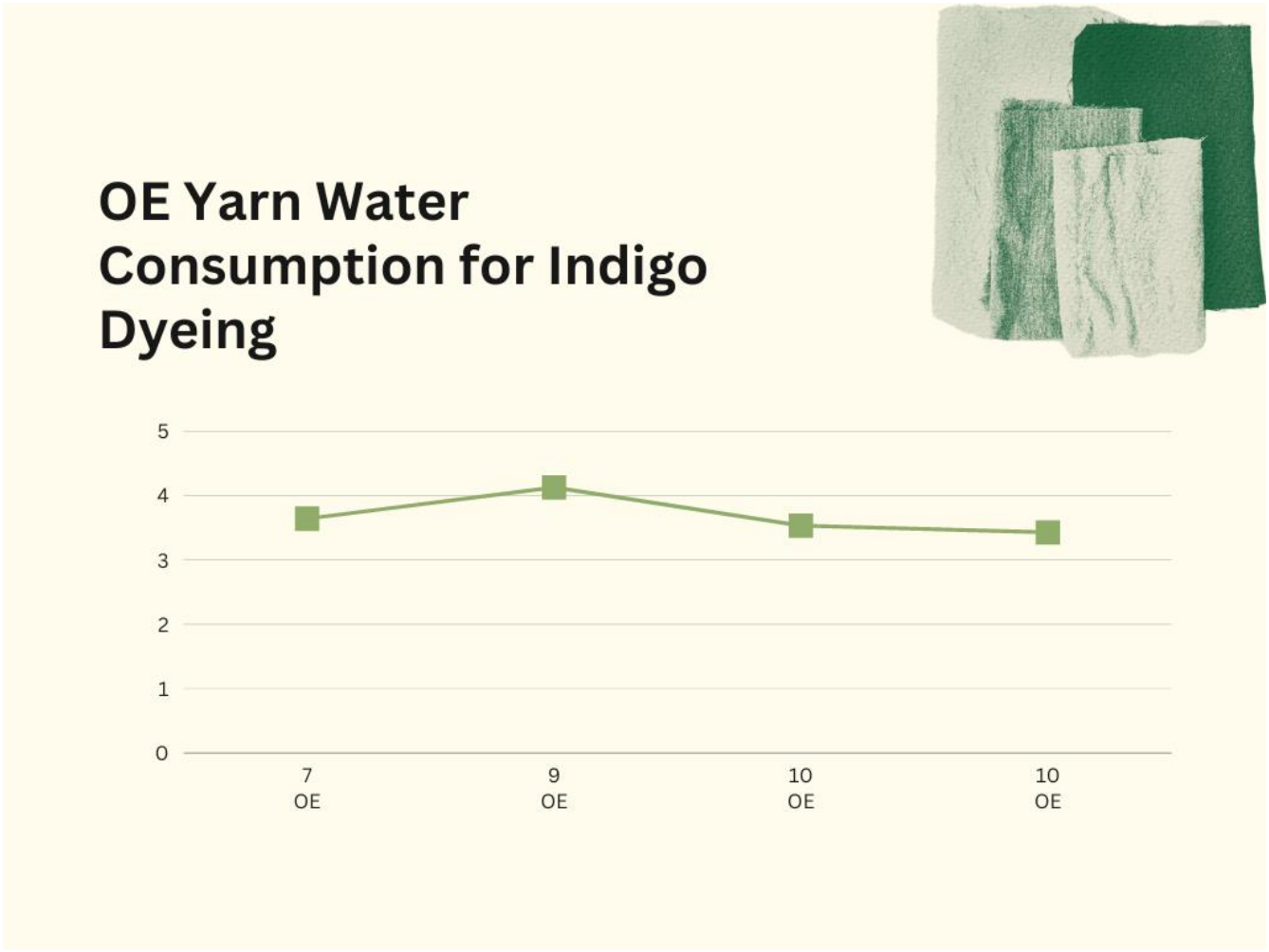
As a result, Machine 2 consumed the most water, followed by Machines 1 and 3 with an average of 37.769, 29.203, and 24.167 liters per kilogram, respectively.

Graph 4.1 shows that due to M2's increased capacity, water consumption increased on a monthly average. The consumption of water in M1, M3 appears to have slightly dropped throughout this time, on the other hand. The least water-intensive types are M2 and M3.

The dyeing machine M3 had the lowest water consumption of the dyeing machines 1, although having a higher capacity, therefore it was not thought to have a significant impact on the overall specific water consumption of dyeing. Therefore, M3 should be viewed as an exception as, in contrast to the others, it frequently generates ecru denim.

4.2 Analysis of `References Wise Water Consumption of Panon Warp Dyeing Machine

4.2.1 ANALYSIS OF WATER CONSUMPTION OF OPEN ENDS YARN FOR INDIGO DYEING

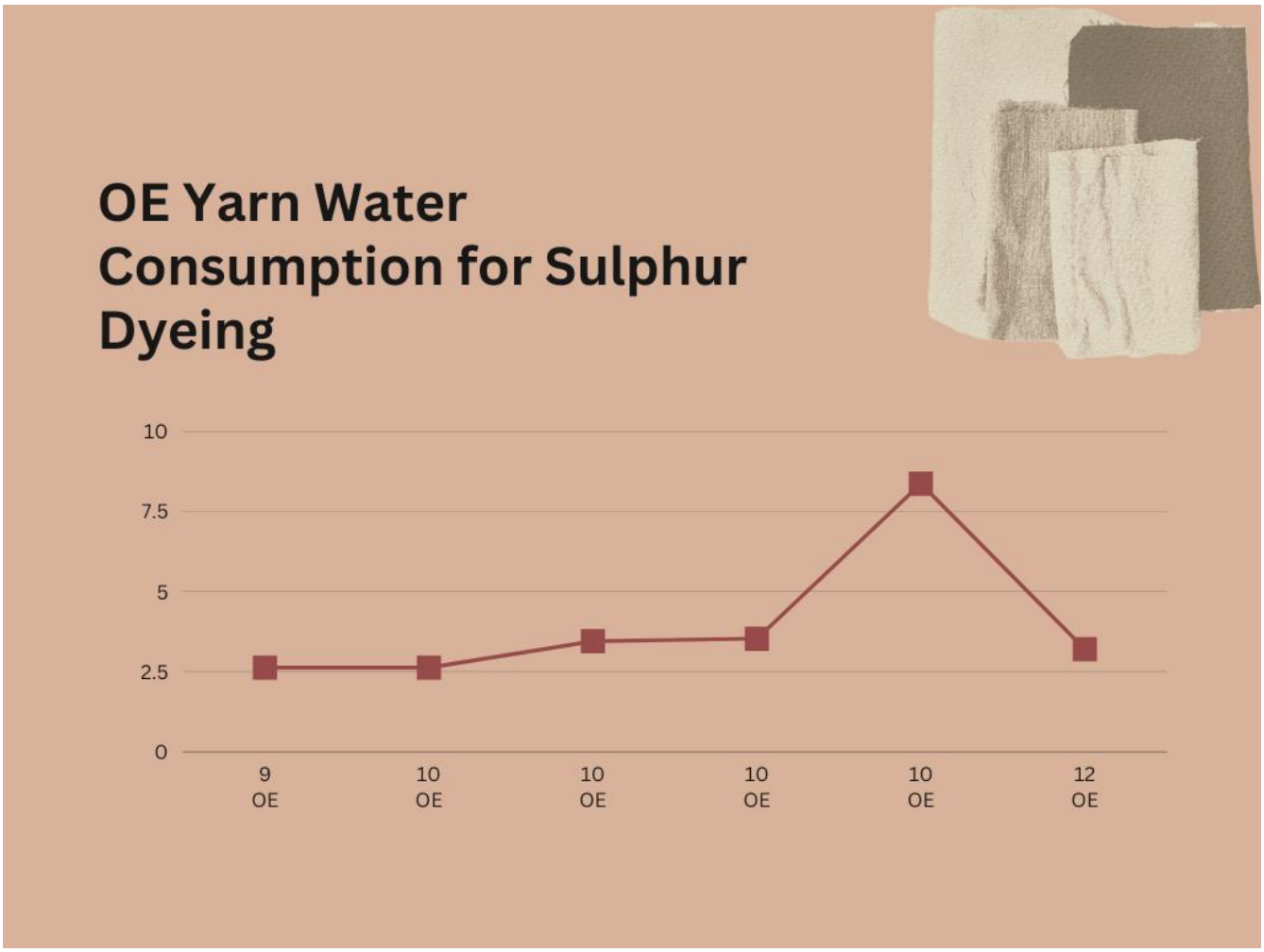


Graph:4.2 Analysis of Water Consumption of Open Ends Yarn for Indigo Dyeing Graph

Findings:

Table 3.3 also allows for the analysis of the water consumptions of the various yarns used in the chosen mill's denim production. **The Graph 4.2** for indigo dyeing shows how the use of water by OE yarn rises as the count does. Water consumption gradually rises for 9OE and 10OE, where it was 4.128 liter per kg and 9.126 liter per kg, compared to 3.643 liter per kg for 7OE.

4.2.2 ANALYSIS OF WATER CONSUMPTION OF OPEN ENDS YARN FOR SULPHUR DYEING

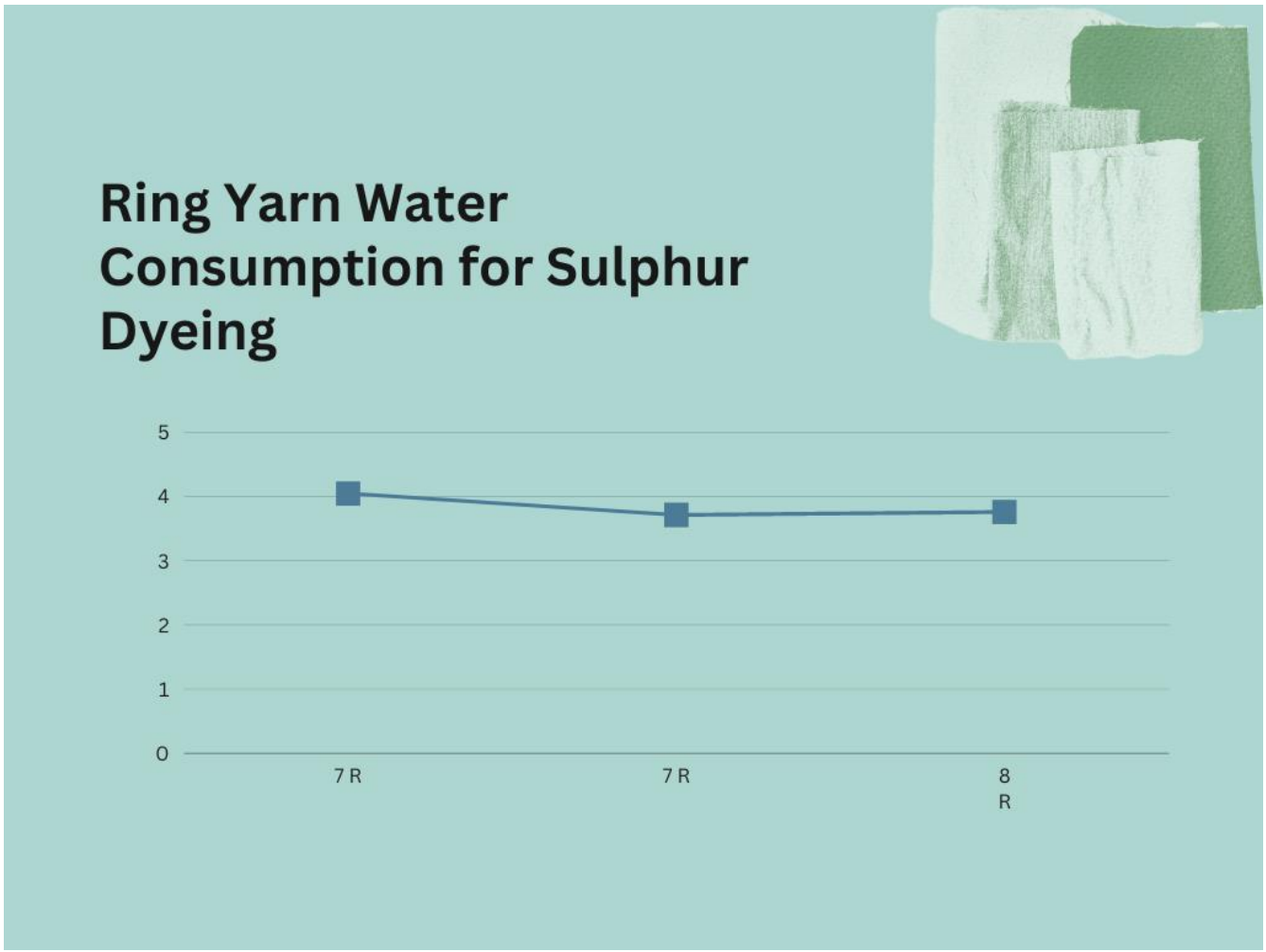


Graph:4.3 Analysis of Water Consumption of Open Ends Yarn for Sulphur Dyeing Graph

Findings:

This is also apparent from the sudden rise in water usage for sulfur dye for OE yarns. For reasons of comparison, we classify all sulfur dyes, including black, ash grey, black bottoming, and black sandwich. The maximum amount of water was consumed for the black sandwich color in 12 OE, as shown in **Graph 4.3.** In addition, the overall water usage was 2.62 for 9OE and 10OE but rapidly increased for 10OE and 12 OE. Additionally, it should be noted that while water consumption for dyeing 10 OE yarn and black bottoming color should be the same, it may vary somewhat due to the usage of BCI cotton.

4.2.3 ANALYSIS OF WATER CONSUMPTION OF RING YARN FOR SULPHUR DYEING

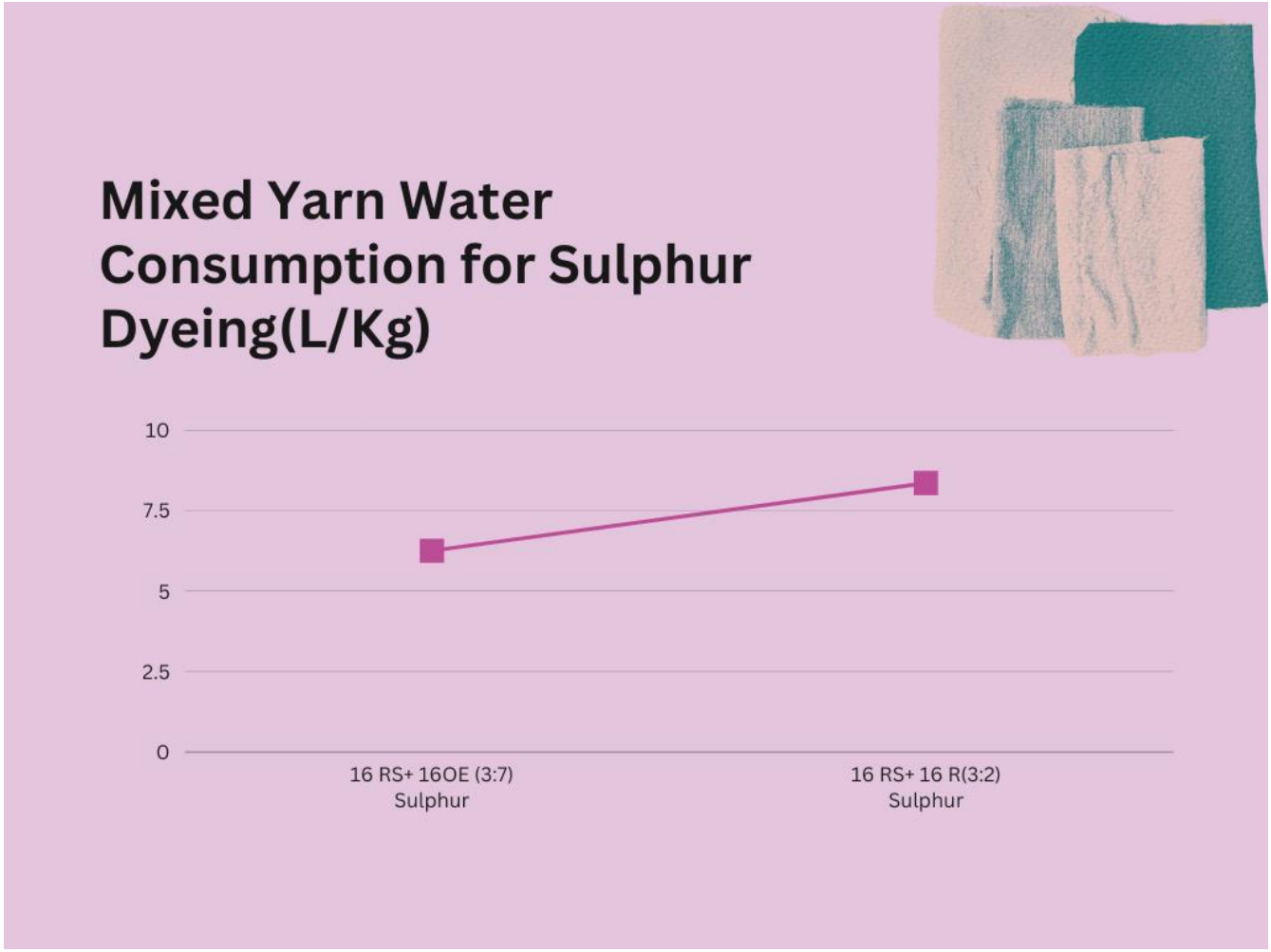


Graph:4.4 Analysis of Water Consumption of Ring Yarn for Sulphur Dyeing Graph

Findings:

Graph 4.4 shows the water consumption of Ring yarns 7R and 8R for various sulfur dye formulations. The 7R yarn uses more water than the 8R yarn, which uses 4.048. However, because a leaser-friendly epic was used in 7R yarn, 8R yarn with sulfur black used almost as little water as 7R yarn.

4.2.4 ANALYSIS OF WATER CONSUMPTION OF Mixed YARN FOR SULPHUR DYEING



Graph:4.5 Analysis of Water Consumption of Mixed Yarn for Sulphur Dyeing Graph

Findings:

Graph 4.5 shows two distinct types of blended yarn so that you can compare the water usage of various yarn blends. Here, we can observe that when 16 RS+16OE(3:7) is used, the water consumption is 6.254 liters per kilogram for black topping, compared to 8.358 liters per kilogram for black bottoming when 16 RS+16R(3:2) is mixed with two different counts of yarn. It should be mentioned at this point that the impacts of the recipe should also be taken into account when assessing the effectiveness of water

consumption in the dyeing process. This is due to the fact that dyeing materials in deeper colors requires the consumption of more water. Thus, the overall water consumption should also take this effect into account.

CHAPTER–5

CONCLUSION

Finding the environmental repercussions of each activity or action, reducing these effects by implementing safeguards, and saving the planet are some of our current biggest issues. Studies of denim water usage may be able to help discover these harmful environmental effects prior to any safeguards being taken. In this study, one kg of yarn dyeing served as a functional unit, and the procedures or stages that within the dyeing parameters of denim fabric production impacted the environment based on water consumption were investigated and evaluated. An factory's water consumption assessment does not always offer a solution to all of its environmental problems, but it does offer a plan of action.

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