Department of Textile Engineering

A Comparative Study on Conventional and Sustainable Wash processes in Denim Garments for Environmental Impacts

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Submitted by:

Md. Rashed
ID: 191-23-5554
Sanzir Islam
ID: 191-23-5506
Md. Arman Bahadur
ID: 191-23-5583

Supervised by:
Md. Mominur Rahman
Assistant Professor
Department Of Textile Engineering
Daffodil International University

A thesis submitted in partial fulfillment of the requirements for the degree of
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Advance in Apparel Manufacturing Technology

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LETTER OF APPROVAL

February 12, 2023

To

The Head

Department of Textile Engineering
Daffodil International University
Daffodil Smart City, Birulia-1216

Subject: Approval of Thesis Report of B.Sc. in TE Program.

Dear Sir

I am just writing to let you know that this report titled as **"A Comparative Study on Conventional and Sustainable Wash processes in Denim Garments for Environmental Impacts"** has been prepared by the student bearing ID 191-23-5583, 191-23-5506 and 191-23-5554 is completed for final evaluation. The whole report is prepared based on the factory data with required belongings. The students were directly involved in their thesis 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.

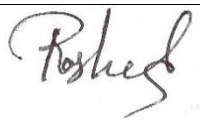
23/02/23

Md. Mominur Rahman
Assistant Professor
Department of Textile Engineering
Faculty of Engineering
Daffodil International University

DECLARATION

We hereby declare that; this project is a presentation of our original research work. Whenever contribution of others is involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgement of collaborative research and discussion.
We also declare neither this project nor any part of this project has been submitted elsewhere for award any degree or diploma.

Submitted By

Name	ID	Signature
Md. Rashed	191-23-5506	
Sanzir Islam	191-23-5554	
Md. Arman Bahadur	191-23-5583	

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Finally, we would like to express a sense of gratitude to our beloved parents & friend for mental support, strength & assistance throughout writing the project report.

DEDICATION

To

Our dignified parents and teacher

may they live long

ABSTRACT

As the faded denim or old look denim is favored by the present youth, washing has become a vital issue for the technologists to change denim attire to satisfy the interest of existing pattern. The primary elements influencing shoppers when choosing articles of clothing are stylish appearance and design. Denim articles of clothing are oppressed in mechanical washing to get explicit appearance and handle. The washing and completing cycles are used with the end goal of design and extraordinary plans are applied for various impacts which are very noteworthy for promoting denim market. Denim also plays a vital role in our economy. The aim of this paper is to find out the effect of changes occurs in physical properties of denim when it is subjected to conventional wash or sustainable wash. To comparing the conventional wash and environment friendly sustainable wash. In the report we try to figure out the changes of Environment Impact for denim after wash and before wash, and compared them to each other. Weight loss percentage also include in the report. We used denim fabric (70% cotton, 28 % polyester 2 % Viscose). We take EMI score for sustainable wash and conventional wash. The EMI score for both tests are measured with the help of lab. This score indicates (0-33 low impact), (34-66 medium impact) above 66 is high impact on environment. Which is not good for environment. We find Sustainable wash chemical, water impact, chemical consumption is less than conventional wash. We try to find out new technology in denim wash, which will be fruitful for this sector and sustainable wash. In this paper with the help of our teacher we tried to know some upcoming technology which is necessary for denim development, like, laser machine, ozone machine effect on denim wash. With the use of these machine denim development will be improved in a sustainable way.

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CHAPTER-1 INTRODUCTION

Denim pants address a normal $60 billion overall market. Style is today inadequate without denim. Denim is a rough cotton twill material, in which the weft goes under two or more twist strings. This twill weaving produces the natural inclining ribbing of the texture, which recognizes denim from cotton duck. It comprises of colored twist and dim weft. The majority of the Denim texture development is either 2/1 or 3/1 development of either left or right gave twill. It is difficult to believe that a comparative denim was at first used in clothing for the pants and overalls worn by diggers on the west coast (US). Different inventive components have added to making denim the style image that it is today fusing gigantic upgrades in turning, weaving, finishing, etc. A champion among the most noteworthy bit of creation of the exquisite denim pants is the washing.

In the material segment article of clothing washing is one of the significant procedures followed in industry. Residue, soil and irresistible materials can be expelled from articles of clothing by mechanical pieces of clothing washing. An assortment of wash strategies can be followed according to form necessity, for improving exceptional look on articles of clothing. Denim washing is tasteful completion given to denim texture to upgrade the interest and to give quality. Dry denim rather than washed denim is a denim texture that isn't washed in the wake of being colored during its creation. A great part of the intrigue of dry denim lies in the way that with time texture will blur in a way like what misleadingly bothered denim endeavors to repeat. With dry denim anyway such blurring is influenced by the body of the individual who wears pants and the exercises of their day-by-day life. This makes what many tumbled to be progressively regular, one of a kind look than pre bothered denim. It is another innovation by which viewpoint, size, comfort capacity and style of a piece of clothing are changed or altered. This innovation was first showed up in Bangladesh in 1988. Before that washing was done uniquely in Hong Kong and Singapore, for example subsequent to sewing articles of clothing were sent to another country for washing and again brought here back for getting done with, labeling and pressing. Accordingly, additional overhead cost (cargo, washing charge, time utilizations) was attracted.

1.1 Objectives of the Report:

The purpose of the Report is to identify the effect of changes due to different washing process. We also try to find out the duties and responsibilities of a service holder as we will go through this Situation soon. Another objective of this Report was to know about the different garments washing process. This Report also includes the different between sustainable wash conventional wash process and changes due to washing on Denim fabric. The specific objectives of the study are describing as follows:

- To reduce the water consumption.
- To reduce the chemical consumption by sustainable wash.
- To identify chemical savings between conventional process and sustainable process.
- To identify how much water saved between conventional and sustainable processes.
- To compare the damages occurred due to washing.
- To observe Environmental impact score by EIM software as per EIM requirements.

1.2 Significance:

Denim sector is developing day by day in our country. Bangladesh exports nearly $1billion worth of denim products to the European countries in a year. In Europe, one in every three persons wears the Bangladeshi denim items. Indeed, Bangladesh overwhelmed China in denim gracefully to the EU nations as a result of value items at serious costs.

- As a fresher textile engineer it is very important to know about the behavior of garments before and after wash. This knowledge will support us some times in planning, sometime in production, some time to full fill the buyer requirement. Denim growth circle in our country is increasing rapidly, so knowledge of denim will be very helpful for our future carrier.
- For a industrial person it is very important to know about environmental impact between conventional and sustainable wash. This knowledge will support to full fill the buyer requirement.
- For a common person it's also very important to know about environmental impact of toxic and hazard chemical and will be concern incase purchase.

1.3 Limitation of Report:

There are some limitations we have faced in report:

- Get short time for machine operate.
- Limited garments for test.
- In our country sustainable wash is not used usually due to lacking of skill worker and machines.
- Don’t get access to take out test garments.

CHAPTER-2 LITERATURE REVIEW

"Sensibility is huge anyway it's lacking. What entirely to happen is we need to close the circle. As opposed to constantly conveying to a consistently expanding degree, we need to make sense of how to reuse what we starting at now have. (1)

H&M rank all denim as demonstrated by Jean logia's device EIM (Environmental Impact Measurement), "30.8% of our denim things have achieved a green level EIM which suggests they used a restriction of 35 liters of water for each piece of clothing during the treatment structures." (2)

2.1 Theoretical Background:

The origin of denim in the world comes from the name of a research organization called Serge, created by the André family in Nimes, France. Originally called Serge de Nimes, the name was soon shortened to denim, which has been used in America since the late 18th century. Denim first came to prominence in 1873 when Jacob W. Davis, a Nevada tailor, created his all-important bolt-on jeans. His idea of creating reinforced pants gained momentum when a customer mentioned jeans that were strong and solid enough for her significant other to split wood. Businessman Levi Strauss and tailor Jacob Strauss Davis delayed the existence of jeans by providing baggers with jean pants made from durable materials and bolting where jeans would normally tear. But very effective.

Due to its high strength, denim was first used for the clothing worn by workers. It was at this time that it became clear that it was largely going mainstream in the 1930s when Hollywood began making cowpoke movies in which entertainers wore pants.

Jeans and denim remained completely different textures and were used in different types of clothing. Denim was mainly used for workwear, while jeans were used for lightweight garments that did not require high durability. By the late 19th century, American weavers were making twill in a manner similar to European denim. Young people began wearing denim as a means of disobedience in the 1950s. Denim was generally blue-shaded with indigo dye to make blue "pants", but "jeans" were more common around this time. meant an alternative lightweight cotton material. The modern use of denim comes from the French word for Genoa, Italy, where the main denim pants are made. In addition to indigo dyeing, denim can also be dyed with sulfur dyes, and denim can be dyed in shades other than indigo.

2.1.1 Sustainability in Textile:

Sustainability is achieved when all people on the planet can live in good health without exchanging personal gratification with future generations." - Rolf Jacker. You may have sex and tendencies and want to live a comfortable life. Be that as it may, this comfort should not be achieved at the expense of the inconvenience or suffering of others. The idea of sustainable improvement seeks to protect people's wealth in the future.

Nature, the earth, biodiversity, and biological systems need to support a comfortable life, not only now, but also in the future. In the 21st century, the material industry is an industry that is rapidly developing both in terms of production volume and business, and the impact of business on the economy is enormous. Similarly, the materials industry is a water-intensive, dry industry that is becoming increasingly scarce. Material businesses have been accused of being one of the most polluting businesses, and as a result, common sense practices must be used to save Mother Nature. Currently, most business samples are adjusted or modified to ensure maintainability, for which measures are essential. Sustainable practices in the materials industry include reducing water usage and using hazardous synthetics, pesticides, and compost. Maintain an eco-friendly design. Diminishing vitality to creative forms. Presenting his 3 R's of reduce, reuse, and recycle. We are also focusing on green commercialization and exploring eco-products. Sustainable principles and recommendations are concerned with the well-being of customers, producers, the general public, and the free-range nature.

2.1.2 What Is Sustainable Denim Wash:

Sustainability is the preservation of the environment and environmental materials through specific methods in the work and manufacture of goods. Here, in the denim washing process, a large amount of water is required for the denim washing process, and necessities such as electricity, gas, and heat are also required for the denim washing process. Methods that can reduce the use of raw materials for production are called sustainability. When washing denim, it should be washed and finished with low consumption of water, electricity, gas, and heat, allowing for a sustainable denim washing process.

First, for sustainability reasons, special chemicals must be used to shorten the cleaning process.

This will act quickly and give you the expected results sooner.

Like (traditional to sustainable)

1. Good quality enzymes can give better salt abrasion results in less time.
2. By using denim washing processing technical materials, you can reduce the number of washings while maintaining the quality of the finish. This way less time is spent and less power is consumed due to shorter timing
3. The use of potassium permanganate can be replaced with laser burning, which can protect the environment, and potash is also very harmful to human health.
4. Abrasion may be laser burnt on some dark-colored garments resulting in less abrasion on the surface of the garment.
5. The manual sharpening/sandblasting process can be shortened, and whisker/sandblasting can be performed by laser baking. This way you save power, reduce manual labor, and increase production with quality standard results.
6. The potash can be reused when washing clothes with a towel/acid wash/acid rain. In this way, the potash solution does not have to be dumped directly into the ground, protecting the environment.
7. Must be reused with heat using literature on denim washing
8. A gas generator heat recovery system can be set up to utilize the heat from the gas generator. Some cleaning steps can also be performed at this 40–45-degree heat limit. (Procedure: decolorization & enzymes, etc.)
9. Some specialty chemicals can be used to neutralize and activate potash and bleach. It is less aggressive than traditional chemicals.

2.1.3 Machine Used in Washing Plant:

- Sample washing machine
- Grinding machine
- Washing machine (Side loading)
- Tagging machine
- Washing machine (Front loading)
- Steam chamber for crinkle
- Hydro extractor machine
- Sand blasting Gun
- Dryer machine (Steam or gas)
- Sand blasting chamber
- Chemical mixture machine • Spray gun and dummy
- Industrial oven (Gas or electric)
- Boiler
- Laser draw
- Generator

2.1.4 Chemicals Used in Washing Plant:

- Enzyme
- Micro emulsion silicon
- Detergent
- Salt (sodium chloride)
- Acetic acid
- Buffer
- Anti-back staining agent
- Hydrogen peroxide
- Bleaching powder
- Stabilizer
- Sodium meta bi sulphite
- Sodium hyposulfite
- Fixing agent
- Caustic soda
- Cutinize
- Soda ash
- Optical brightener
- Sodium bicarbonate
- Resin
- Potassium permanganate

2.2 Environmental Pollution Facts of Conventional:

We should be honest. Denim is a very dirty industry. Making pants is like making sausages. For this reason, this is usually done in poorer countries where natural guidelines are not clearly outlined. Despite the realities of nature, denim is still evolving in the design market. It is especially important to look at it in light of the fact that washing denim is one of the dirtiest processing techniques. The reality was considered around 2010. However, commonly used innovations are more environmentally friendly as environmentally hazardous plastic mixtures are used today than indoors and outdoors, and the disadvantages of sewage treatment plants include high vitality and water usage. , multi-part production processes and waste bundles are supported. A denim expert's effort to design new and better-condition products. Undoubtedly; increased popularity has led to higher prices for goods, and this is firmly tied to the notably miserable working conditions of denim shop workers around the world.

2.3 Sustainable Denim Processing Technology:

2.3.1 Ozone Fading:

The fabric is bleached in a washing machine with dissolved ozone in water for denim washing by ozone. Denim clothing may also be bleached or stained in a closed room, using ozone gas. Some of the techno-environmental benefits of ozone-based denim processing are:

1. Minimal loss of fabric strength.
2. a straightforward process
3. low exposure to water and chemicals;
4. process economics. The process is simple and environmentally friendly, as ozonated water can be easily demonized using ultraviolet light. Ozone as a Bleach and Disinfectant Ozone air (gasoline) generally acts as a mild bleach and disinfectant. The color changes from blue to white. In this method of washing denim, a machine takes air from the environment, directs it, and separates it into basic segments. As a result, oxygen (O2) is purified and improved, O2 atoms are changed to O3 particles by high voltage, and ozone gas is generated. The resulting ozone is injected into the tumbler that washes the pants. Faded denim typically ages as if the sun has disappeared. Toward the end of the dyeing cycle, the ozone is sucked out of the drum and mixed with the air conditioner fraction to become oxygen before being released into the air.

2.3.2 Plasma Technology:

Advances in lasers and plasmas have shown the potential to achieve a variety of surface texture effects with less water and lesser synthetic materials. Synthetically, attractive plasma emissions are used by various companies to modify specific surface properties of materials. It has also been widely used in material handling for the last 20 years. Washing denim clothes is a polluting process in fabric shops. However, when plasma is applied to jeans, it limits or maintains a strategic distance from water use inside and out. To date, plasma infusion has been used primarily for staining indigo and sulfur-colored denim garments. Commonly, cold oxygen plasma is used for resizing and shading denim material. Washed denim is almost always an attractive look to garments, a time-consuming and environmentally damaging process.

2.3.2 Laser Technologies:

Laser cleaning does not use water, stones, or sand to clean your pants. The wash process is finished by penetrating the pants with a laser. The procedure is quick and the wash looks great. This waterless innovation can give denim that much-needed 'shabby' or 'vintage' look. The laser is applied to denim and pants garments in lieu of potassium permanganate (PP) splattering. Lasers are the source of life force, and their power and power can be precisely controlled. It is fed by a mixture of CO2 + direct current. Aim the laser at the texture according to the power required. There are three sections: Laser m/c PC section, Siler section (synthetic segment), and Laser section. The working bed can have a honeycomb structure or metal stanchions or metal bars (also with small openings).

2.4 EIM Software by JEANOLOGIA

EIM Software

EIM is a clear and transparent tool that provides reliable measures to help identify where the impact is greatest and determine efficient action plans to improve garment finishing processes. Because we believe that the first step to minimize this impact is to properly assess the best points to improve... Too often aspects are misunderstood, and through EIM it is easier to visualize viable goals that will really make a difference. EIM provides valuable information to determine if your garment finishing efforts lead in the mid and long term to the desired

objective:

THE REDUCTION OF THE IMPACT ON OUR ENVIRONMENT.

If there is no measurement, there is no improvement. The EIM, Environmental Impact Measuring software, is a unique and powerful platform developed to monitor environmental impact of garment finishing processes. EIM was created to provide the laundries, garment finishers and brands with a tool that helps them to build more sustainable processes in an efficient and economically viable way.

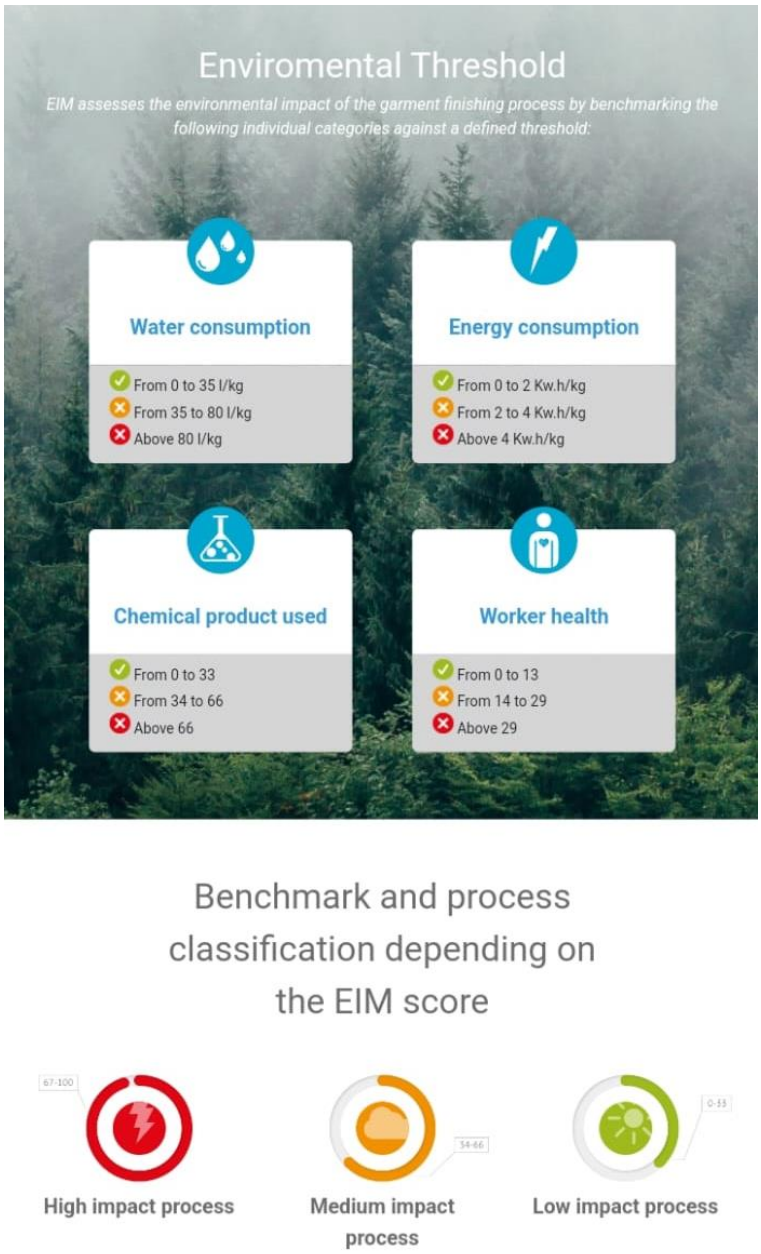


Figure 1: Environment Threshold

CHAPTER-3 METHODOLOGY

3.1 Material

Denim Garments was collected from Denim Universe-Unit 1 and 2 at BEXIMCO Textile Division. Fabric GSM was 315 Before Wash and Shrinkage was -3%.

Table 1: Fabric Composition

Cotton	70%
Polyester	28%
Spandex	2%

Chemical and Auxiliaries:

Table 2: Chemical and Auxiliaries

SL	Chemical name	Brand name	Function
1	Lycra Protector	Protector LY	eliminates the problem of shrinkage and breakage of stress yarn.
2	Detergent	Eco size CLD 100 GS	Remove size material
3	E-flow enzyme	ATB 710	Used for fading effect by nanobubble.
4	Bleaching agent	Sodium Hypochloride	Remove color from denim garments
5	Sodium metabisulfite	S-Meta	Neutral the garment, after bleaching neutral must be needed
6	Salt	Glauber salt	Increase dye affinity toward fabric
7	Softener	Fdc softener	Increase Hand feel

8	Potassium permanganate	Potash	Used in washing plant for color out from the denim garments
9	Phosphoric acid	Acid	Ph Maintain in PP Solution
10	Anti-Back Staining	Polynol ABS Cone	Reduce Pocket cleaner. Stop Color Bleeding at Pocket White fabric.

3.2 Method

3.2.1 Recipe 1 for Conventional and Sustainable

3.2.1.1 Data Table Conventional

Table 3: Recipe 1 for Conventional

Desizing							
Operation	L: R	Water Liter	Temp ℃	Time Min	Dose G/L %	Chemical Name	Total Quantity
Insert Product	1: 5	2.5 L	50℃	10	1.00%	Eco size CLD 100GS	5 gm
					2.00%	Anti-Back Staining	10 gm
Drain							
Rinse	1: 6	3 L	25℃	2			
Drain							
Enzyme Wash							
Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
Insert Product	1: 5	2.5L	50℃	30	2.00%	Enzyme (Cellulase)	10 gm
					2.00%	Anti-Back Staining	10 gm
Drain							
Rinse	1: 6	3 L		2			
Drain							

Hydro Extractor: RPM: 200 Time: 3 min

Denim Bleaching								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 6	3 L	50℃	8	5.00%	Sodium Hypochlorite	25 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			
04	Drain							

Chlorine Neutralization								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	45℃	5	2.00%	Sodium Meta Sulphate	10 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			
04	Drain							

Hydro Extractor: Time-5min RPM-200

Dryer: Time-25min, Tempereture-80℃

PP Spray								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product				30 Sec	5gm/L	Potassium Permanganate	
						3gm/L	Phosphoric acid	

PP Neutralization								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	45℃	5	2.00%	Sodium Meta bi Sulphite	10 gm
						2.00%	Anti-Back Staining	10 gm
02	Drain							
03	Rinse	1: 6	3 L	40℃	2			
04	Drain							

Cleaning								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	50℃	10	1.00%	Soda Ash	5 gm
						2.00%	Hydrogen peroxide	10 gm
						1.00%	Anti-back Staining	5 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			

Softening								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	45℃	5	5.00%	Cationic Softener	25 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			
04	Drain							

Hydro: Time- 5Min RPM-200

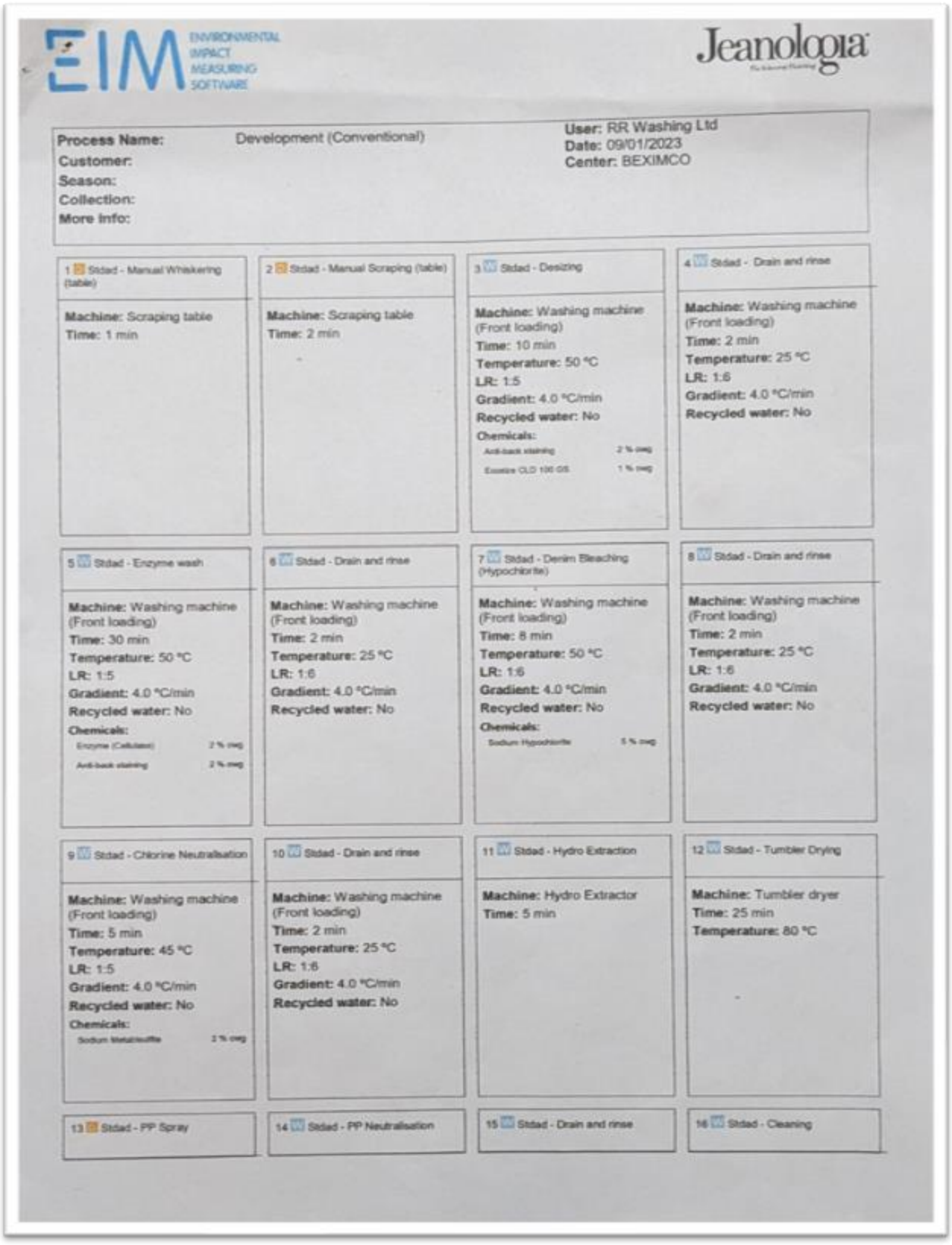
Dryer: Time- 25Min, Temperature-80℃

3.2.1.2 Dry Process in Conventional

Table 4: Dry Process in Conventional Recipe 1

Dry process		
Process name	Time	Manpower
Whisker	2min	4
Hand Scraping	2 min	2
PP spray	1min	3

3.2.1.3 Recipe made by Software for Conventional



EIM ENVIRONMENTAL IMPACT MEASURING SOFTWARE

Jeanologia

Process Name: Development (Conventional)
Customer:
Season:
Collection:
More info:

User: RR Washing Ltd
Date: 09/01/2023
Center: BEXIMCO

1 Stdad - Manual Whiskering (table)
Machine: Scraping table
Time: 1 min

2 Stdad - Manual Scraping (table)
Machine: Scraping table
Time: 2 min

3 Stdad - Desizing
Machine: Washing machine (Front loading)
Time: 10 min
Temperature: 50 °C
LR: 1:5
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Anti-back staining 2 % owg
Exoslire CLD 100 GS 1 % owg

4 Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

5 Stdad - Enzyme wash
Machine: Washing machine (Front loading)
Time: 30 min
Temperature: 50 °C
LR: 1:5
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Enzyme (Cellulase) 2 % owg
Anti-back staining 2 % owg

6 Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

7 Stdad - Denim Bleaching (Hypochlorite)
Machine: Washing machine (Front loading)
Time: 8 min
Temperature: 50 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Sodium Hypochlorite 5 % owg

8 Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

9 Stdad - Chlorine Neutralisation
Machine: Washing machine (Front loading)
Time: 5 min
Temperature: 45 °C
LR: 1:5
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Sodium Metabisulfite 2 % owg

10 Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

11 Stdad - Hydro Extraction
Machine: Hydro Extractor
Time: 5 min

12 Stdad - Tumbler Drying
Machine: Tumbler dryer
Time: 25 min
Temperature: 80 °C

13 Stdad - PP Spray

14 Stdad - PP Neutralisation

15 Stdad - Drain and rinse

16 Stdad - Cleaning

Figure 2: Recipe made by Software for Conventional.

3.2.1.4 EIM Score for Conventional in Recipe 1

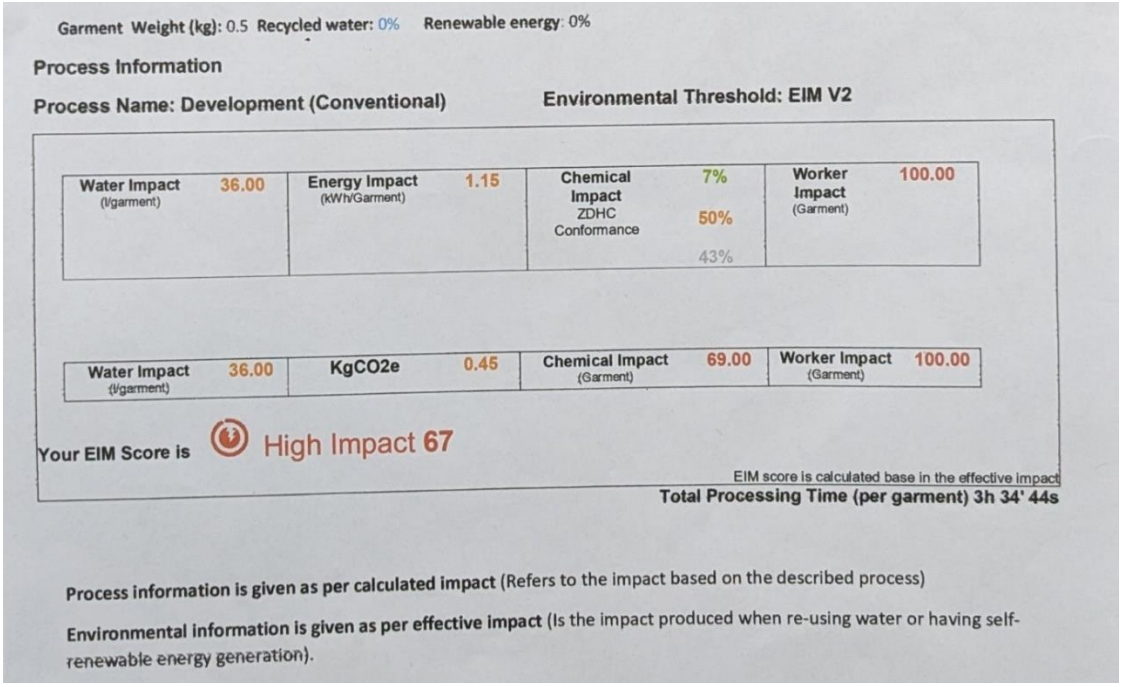


Figure 3: EIM Score for Conventional in Recipe 1

3.2.1.5 Data Table for Sustainable

Table 5: Recipe 1 for Sustainable

Pre-Ozone (50%)						
L: R	Water Liter	Temp ℃	Time Min	Dose G/L %	Chemical Name	Total Quantity
			10		50% Ozone	
N/A	N/A	Room	2			

E flow Enzyme								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 0.5	0.25 L	25℃	30	2 %	ATB 710	10 gm
02	Drain							
03	Hot Rinse	1: 5	2 L	45℃	2			
04	Drain							

Hydro Extractor: RPM: 200 Time: 3 min

Ozone fading (40%)									
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	Wet garments			10 min				

Bio Polishing								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 4	2 L	40℃	10	1 %	Sokostone NLC	5 gm
02	Drain							
03	Rinse	1: 5	2.5 L	40℃	2			
04	Drain							

Hydro: Time: 5 min, RPM: 200

Dryer: Time: 25 min, Temperature: 80℃

E flow Softening								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 0.5	0.25 L	25℃	7 min	3 %	Lava Soft EPS	15 gm
02	Drain							
03	Rinse	1: 6	3 L	℃	2			
04	Drain							

Hydro Extractor: Time: 5 min RPM: 200

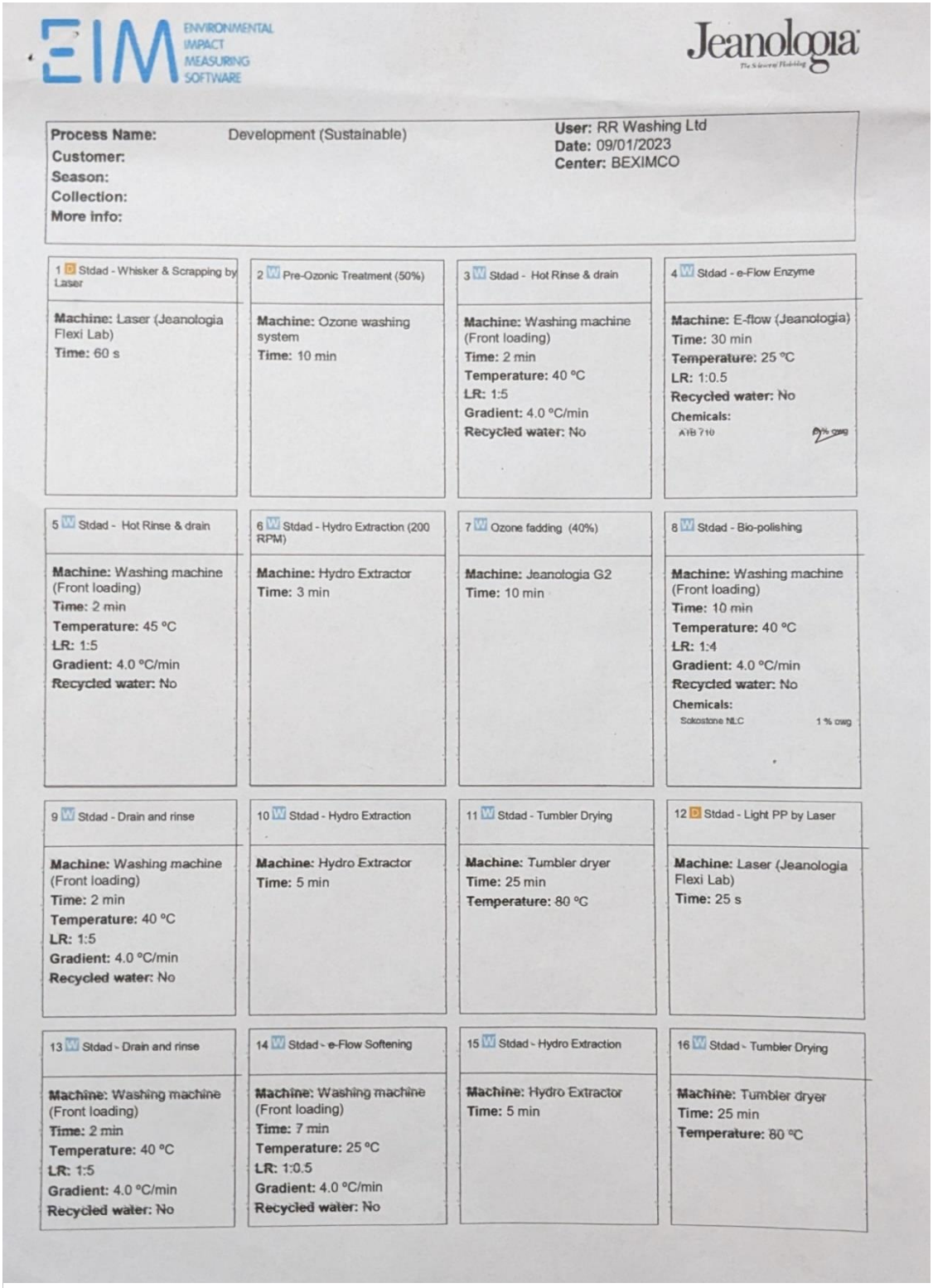
Dryer: Time: 25 min Temperature: 80℃,

3.2.1.6 Dry Process in Sustainable

Table 6: Dry Process in Sustainable Recipe 1

Dry process		
Process name	Time	Manpower
Laser Whisker	1min	1
Scarping	1min	

3.2.1.7 Recipe 1 made by Software for Sustainable



EIM ENVIRONMENTAL IMPACT MEASURING SOFTWARE

Jeanologia

Process Name: Development (Sustainable)
Customer:
Season:
Collection:
More info:

User: RR Washing Ltd
Date: 09/01/2023
Center: BEXIMCO

1 Stdad - Whisker & Scrapping by Laser	2 Pre-Ozonic Treatment (50%)	3 Stdad - Hot Rinse & drain	4 Stdad - e-Flow Enzyme
Machine: Laser (Jeanologia Flexi Lab) **Time:** 60 s	**Machine:** Ozone washing system **Time:** 10 min	**Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	**Machine:** E-flow (Jeanologia) **Time:** 30 min **Temperature:** 25 °C **LR:** 1:0.5 **Recycled water:** No **Chemicals:** AIB 710

5 Stdad - Hot Rinse & drain	6 Stdad - Hydro Extraction (200 RPM)	7 Ozone fadding (40%)	8 Stdad - Bio-polishing
Machine: Washing machine (Front loading) **Time:** 2 min **Temperature:** 45 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	**Machine:** Hydro Extractor **Time:** 3 min	**Machine:** Jeanologia G2 **Time:** 10 min	**Machine:** Washing machine (Front loading) **Time:** 10 min **Temperature:** 40 °C **LR:** 1:4 **Gradient:** 4.0 °C/min **Recycled water:** No **Chemicals:** Sokostone NLC 1 % owg

9 Stdad - Drain and rinse	10 Stdad - Hydro Extraction	11 Stdad - Tumbler Drying	12 Stdad - Light PP by Laser
Machine: Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	**Machine:** Hydro Extractor **Time:** 5 min	**Machine:** Tumbler dryer **Time:** 25 min **Temperature:** 80 °C	**Machine:** Laser (Jeanologia Flexi Lab) **Time:** 25 s

13 Stdad - Drain and rinse	14 Stdad - e-Flow Softening	15 Stdad - Hydro Extraction	16 Stdad - Tumbler Drying
Machine: Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	**Machine:** Washing machine (Front loading) **Time:** 7 min **Temperature:** 25 °C **LR:** 1:0.5 **Gradient:** 4.0 °C/min **Recycled water:** No	**Machine:** Hydro Extractor **Time:** 5 min	**Machine:** Tumbler dryer **Time:** 25 min **Temperature:** 80 °C

Figure 4: Recipe made by Software for Sustainable

3.2.1.8 EIM Score for Sustainable in Recipe 1

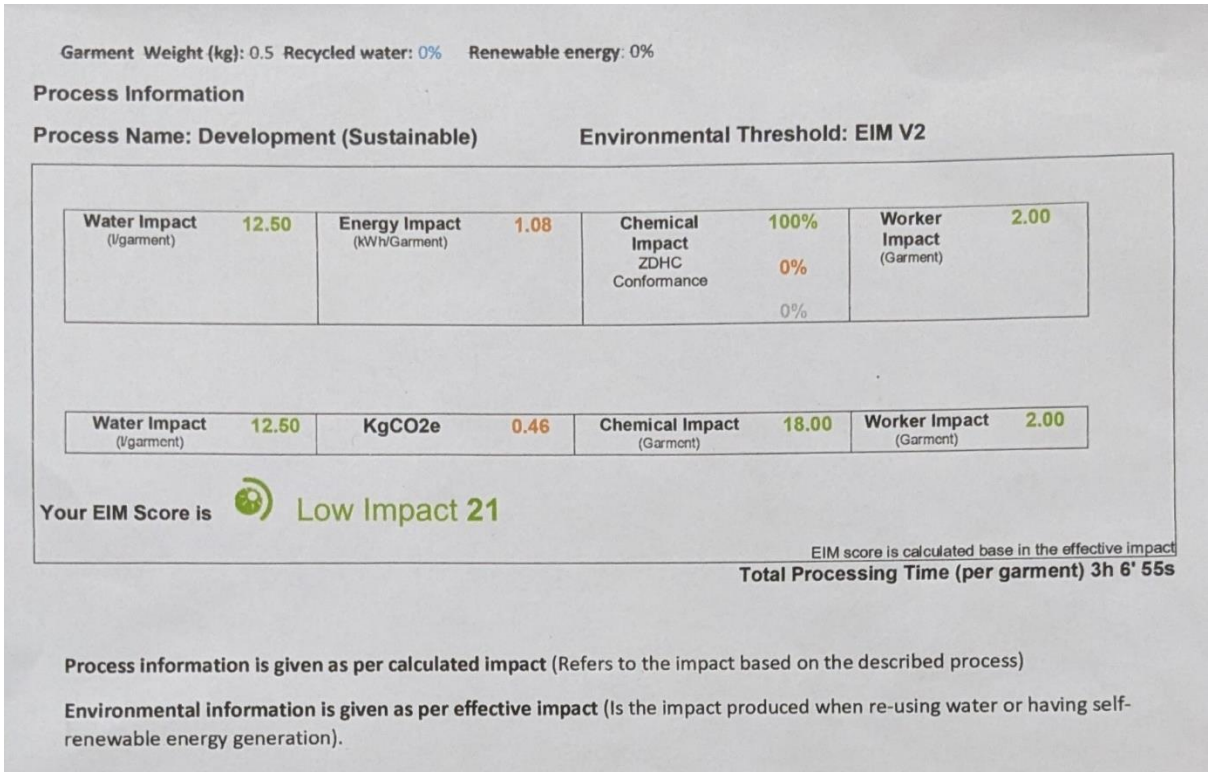


Figure 5: EIM Score for sustainable in Recipe 1

3.2.1.9 Conventional and Sustainable Environment Impact in Recipe 1

Table 7: Conventional and Sustainable Environment Impact in Recipe 1

Method	Weight	Water (L)	Energy (KWh)	Chemical (gm)	Chemical (%)	KgCO2e	Worker	EIM Score
Conventional Environment Threshold	0.5 kg	36 L	1.15	145 gm	69 %	0.45	100	67
Sustainable Environment Threshold	0.5 kg	12.5	1.08	30 gm	18 %	0.46	2	21

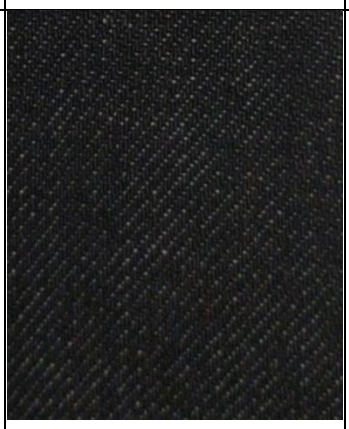
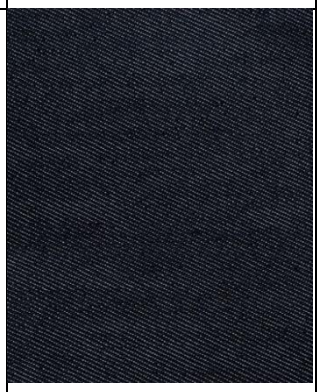
3.2.1.10 Total Water and Chemical Saving in Recipe 1

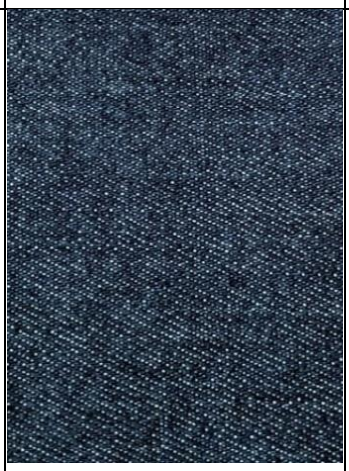
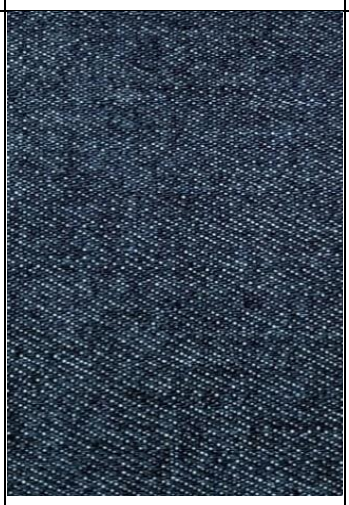
Table 8: Total Water and Chemical Saving in Recipe 1

Amount of water saving (L)	Water Saving (%)	Amount of Energy saving (%)	Amount of Chemical saving (%)	Total Chemical Saving (gm)	KgCO2e	Worker	EIM Score
23.5 L	65.3 %	5.9%	79.3%	115 gm	-3.1%	98 %	69%

3.2.1.11 Swatch Compare Between Sustainable & Conventional

Table 9: Swatch Compare Between Sustainable & Conventional Recipe 1

Process Name	**Conventional Wash Recipe 1**	**Process Name**	**Sustainable Wash Recipe 1**
Unwashed		Unwashed	
Desizing		Pre-Ozone (50%)	

Enzyme Wash		E-flow Enzyme	
Denim Bleaching		Ozone fading (40%)	
Softening		E-flow Softening	

3.2.2 Recipe 2 for Conventional and Sustainable

3.2.2.1 Data Table Conventional

Table 10: Recipe 2 for Conventional

Desizing

SL.NO	Operation	L: R	Water Liter	Temp ℃	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 6	3 L	50℃	10	2.00%	Eco size CLD 100GS	10 gm
						2.00%	Anti-Back Staining	10 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			
04	Drain							

Enzyme Wash

Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
Insert Product	1: 6	3 L	50℃	30	3.00%	Enzyme (Cellulase)	15 gm
					2.00%	Anti-Back Staining	10 gm
Drain							
Rinse	1: 6	3 L		2			
Drain							

Denim Bleaching

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 7	3.5 L	50℃	15	8.00%	Sodium Hypochlorite	15 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			

Chlorine Neutralization

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 6	3 L	45℃	5	2.00%	Sodium Meta Sulphate	10 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			
04	Drain							

Hydro Extractor: Time-5min RPM-200

Dry: Time-25min Temp-80℃

PP Spray

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product				30 Sec		Potassium Permanganate	5gm/L
							Phosphoric acid	3gm/L

PP Neutralization

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	45℃	5	2.00%	Sodium Meta bi Sulphite	10 gm
						2.00%	Anti-Back Staining	10 gm
02	Drain							
03	Rinse	1: 6	3 L	40℃	2			
04	Drain							

Cleaning									
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	50°C	10		2.00%	Soda Ash	10 gm
							2.00%	Hydrogen peroxide	10 gm
							1.00%	Anti-back Staining	5 gm
02	Drain								
03	Rinse	1: 6	3 L	25°C	2				

Softening									
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 6	3 L	45°C	10		10.00%	Cationic Softener	50 gm
02	Drain								
03	Rinse	1: 6	3 L	25°C	2				
04	Drain								

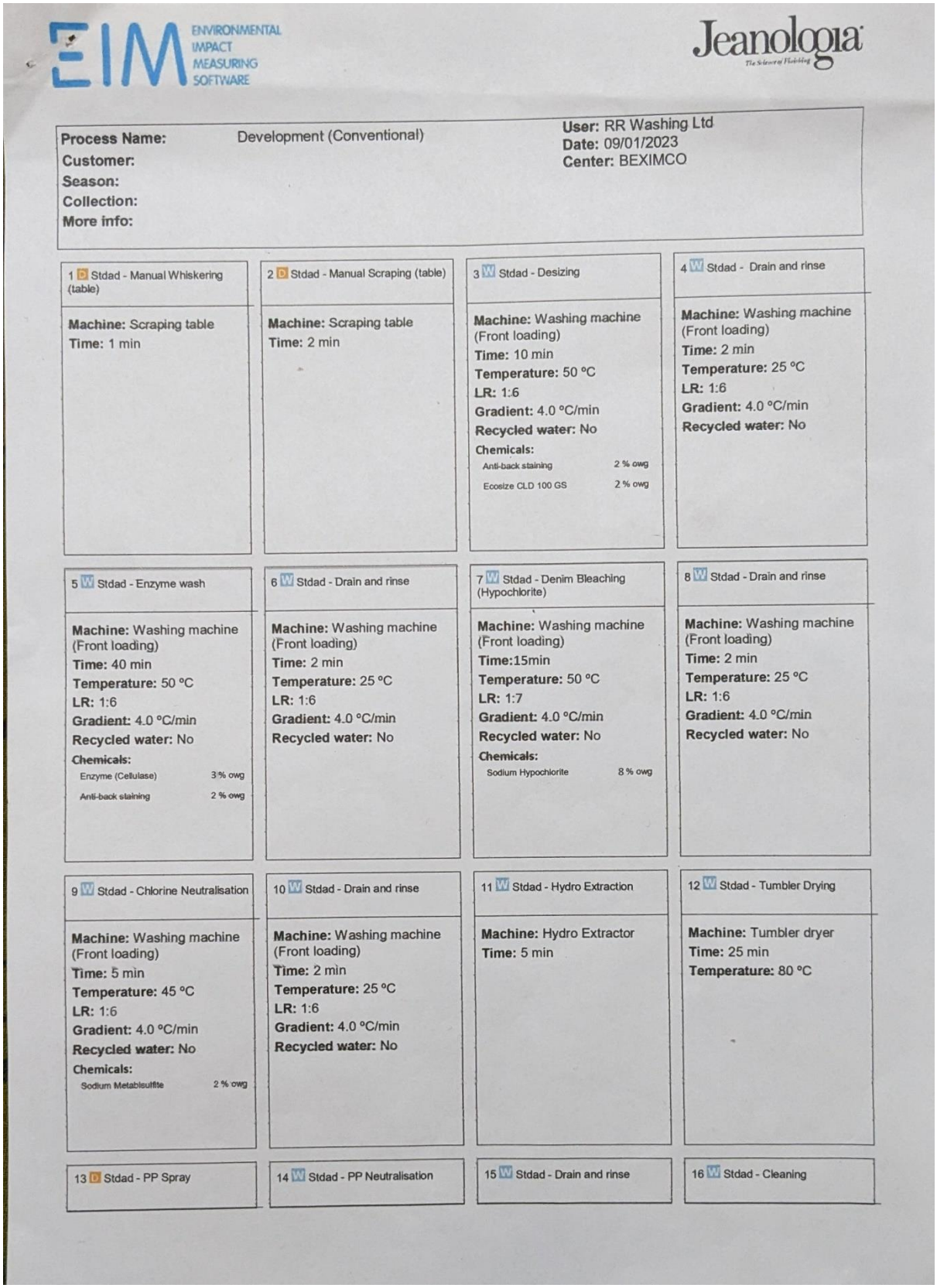
Hydro Extractor: Time-3min RPM-200

3.2.2.2 Dry Process in Conventional

Table 11: Dry Process in Conventional Recipe 2

Dry process		
Process name	Time	Manpower
Whisker	2min	4
Hand Scraping	2 min	2
PP spray	1min	3

3.2.2.3 Recipe 2 made by Software for Conventional



EIM ENVIRONMENTAL IMPACT MEASURING SOFTWARE

Jeanologia The Science of Finishing

Process Name: Development (Conventional)
Customer:
Season:
Collection:
More info:

User: RR Washing Ltd
Date: 09/01/2023
Center: BEXIMCO

1 D Stdad - Manual Whiskering (table)
Machine: Scraping table
Time: 1 min

2 D Stdad - Manual Scraping (table)
Machine: Scraping table
Time: 2 min

3 W Stdad - Desizing
Machine: Washing machine (Front loading)
Time: 10 min
Temperature: 50 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Anti-back staining 2 % owg
Ecosize CLD 100 GS 2 % owg

4 W Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

5 W Stdad - Enzyme wash
Machine: Washing machine (Front loading)
Time: 40 min
Temperature: 50 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Enzyme (Cellulase) 3 % owg
Anti-back staining 2 % owg

6 W Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

7 W Stdad - Denim Bleaching (Hypochlorite)
Machine: Washing machine (Front loading)
Time:15min
Temperature: 50 °C
LR: 1:7
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Sodium Hypochlorite 8 % owg

8 W Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

9 W Stdad - Chlorine Neutralisation
Machine: Washing machine (Front loading)
Time: 5 min
Temperature: 45 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Sodium Metabisulfite 2 % owg

10 W Stdad - Drain and rinse
Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

11 W Stdad - Hydro Extraction
Machine: Hydro Extractor
Time: 5 min

12 W Stdad - Tumbler Drying
Machine: Tumbler dryer
Time: 25 min
Temperature: 80 °C

13 D Stdad - PP Spray

14 W Stdad - PP Neutralisation

15 W Stdad - Drain and rinse

16 W Stdad - Cleaning

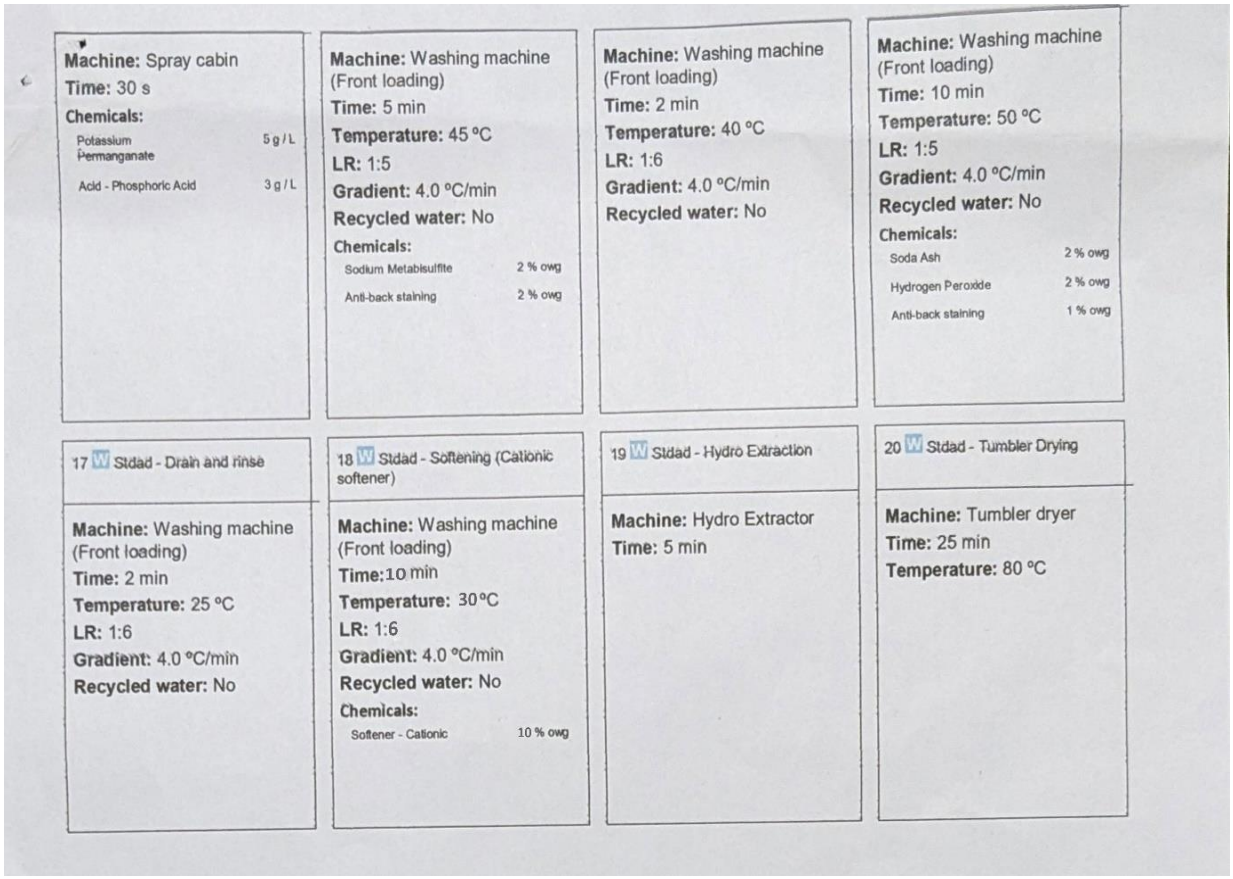


Figure 6: Recipe 2 made by Software for Conventional

3.2.2.4 EIM Score for Conventional in Recipe 2

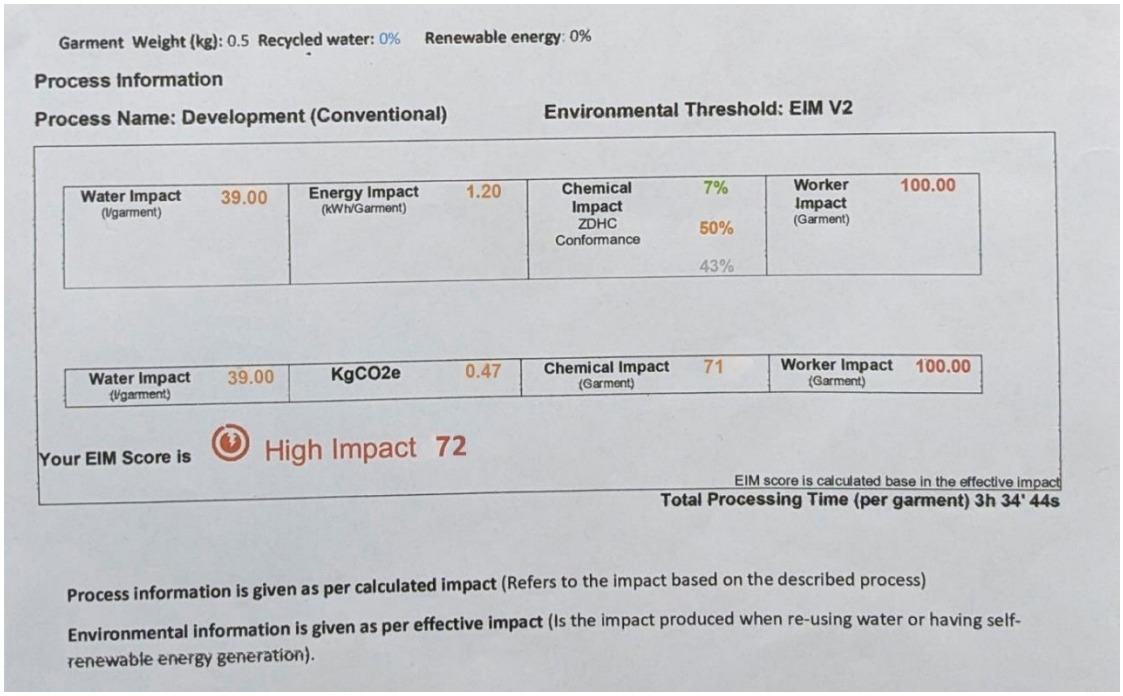


Figure 7: EIM Score for Conventional in Recipe 2

3.2.2.5 Data Table for Sustainable

Table 12: Recipe 2 for Sustainable

Pre-Ozone (50%)

SL.NO	Operation	L: R	Water Liter	Temp ℃	Time Min	Chemical Name	Total Quantity
01	Insert Product	**Dry garments**			12	50% Ozone	
02	Hot Rinse	1: 5	2 L	40℃	2		

E flow Enzyme

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 0.5	0.25 L	25℃	40	3 %	ATB 710	15 gm
02	Drain							
03	Hot Rinse	1: 5	2 L	45℃	2			
04	Drain							

Hydro Extractor: Time: 3 min RPM: 200

Ozone fading (40%)

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Chemical Name	Total Quantity
01	Insert Product	**Wet garments**			18 min		
02	Hot Rinse	1: 5	2 L	40℃	2		

Bio Polishing								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2.5 L	40℃	10	2.00 %	Sokostone NLC	10 gm
02	Drain							
03	Rinse	1: 5	2.5 L	40℃	2			
04	Drain							

Hydro: Time:5 min RPM:200

Dryer: Time:25 min, Temp:80℃

E flow Softening								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 0.5	0.25 L	25℃	10 min	3 %	Lava Soft EPS	15 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			
04	Drain							

Hydro: Time:5 min RPM:200

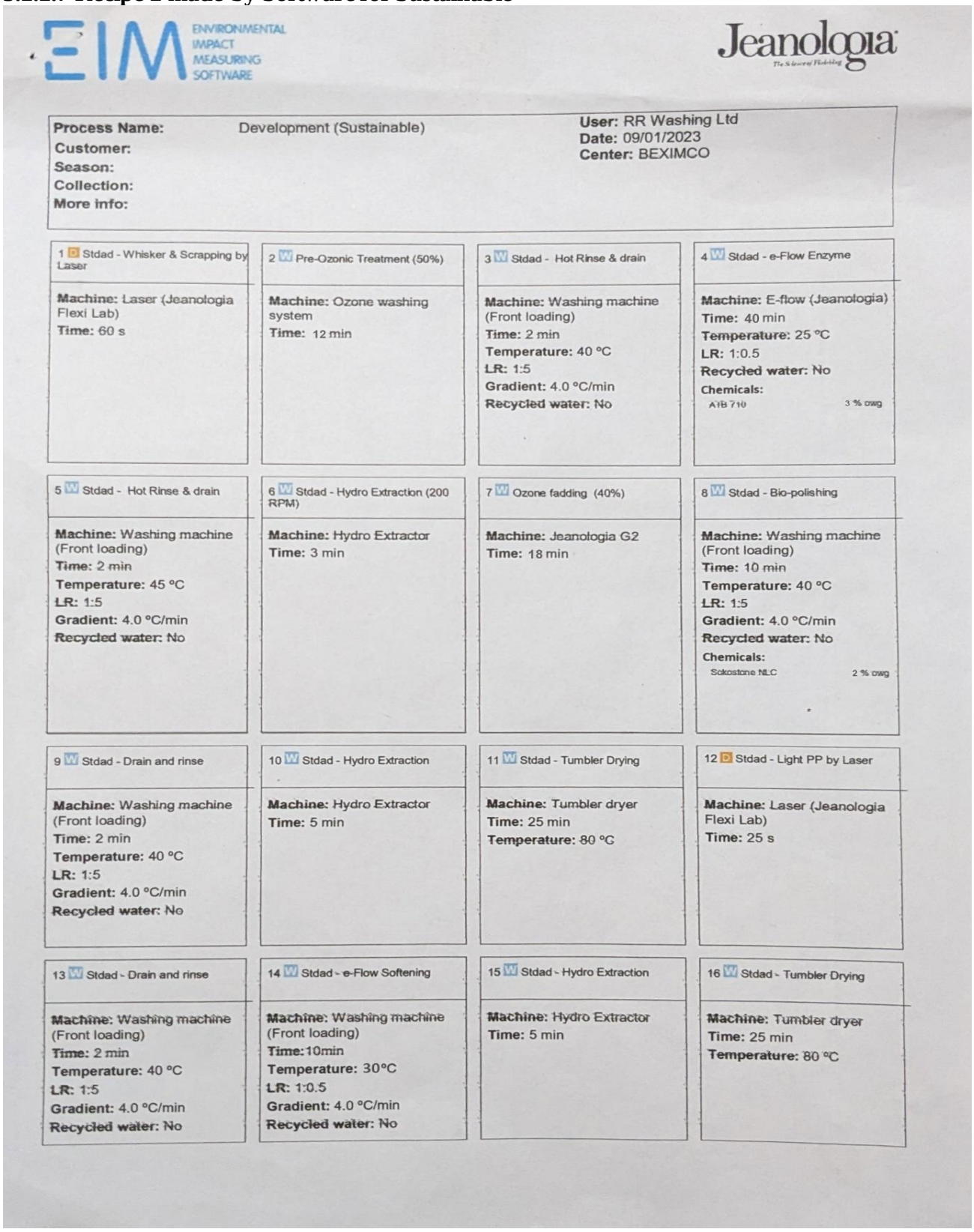
Dryer: Time:25 min, Temp:80℃

3.2.2.6 Dry Process in Sustainable

Table 13: Dry Process in Sustainable Recipe 2

Dry process		
Process name	Time	Manpower
Laser Whisker	1min	1
Scarping	1min	

3.2.2.7 Recipe 2 made by Software for Sustainable



ENVIRONMENTAL IMPACT MEASURING SOFTWARE

Jeanologia

Process Name: Development (Sustainable)
Customer:
Season:
Collection:
More info:

User: RR Washing Ltd
Date: 09/01/2023
Center: BEXIMCO

1 D Stdad - Whisker & Scrapping by Laser **Machine:** Laser (Jeanologia Flexi Lab) **Time:** 60 s	2 W Pre-Ozonic Treatment (50%) **Machine:** Ozone washing system **Time:** 12 min	3 W Stdad - Hot Rinse & drain **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	4 W Stdad - e-Flow Enzyme **Machine:** E-flow (Jeanologia) **Time:** 40 min **Temperature:** 25 °C **LR:** 1:0.5 **Recycled water:** No **Chemicals:** ATB 710 3 % owg
5 W Stdad - Hot Rinse & drain **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 45 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	6 W Stdad - Hydro Extraction (200 RPM) **Machine:** Hydro Extractor **Time:** 3 min	7 W Ozone fadding (40%) **Machine:** Jeanologia G2 **Time:** 18 min	8 W Stdad - Bio-polishing **Machine:** Washing machine (Front loading) **Time:** 10 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No **Chemicals:** Sokostone NLC 2 % owg
9 W Stdad - Drain and rinse **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	10 W Stdad - Hydro Extraction **Machine:** Hydro Extractor **Time:** 5 min	11 W Stdad - Tumbler Drying **Machine:** Tumbler dryer **Time:** 25 min **Temperature:** 80 °C	12 D Stdad - Light PP by Laser **Machine:** Laser (Jeanologia Flexi Lab) **Time:** 25 s
13 W Stdad - Drain and rinse **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	14 W Stdad - e-Flow Softening **Machine:** Washing machine (Front loading) **Time:** 10min **Temperature:** 30°C **LR:** 1:0.5 **Gradient:** 4.0 °C/min **Recycled water:** No	15 W Stdad - Hydro Extraction **Machine:** Hydro Extractor **Time:** 5 min	16 W Stdad - Tumbler Drying **Machine:** Tumbler dryer **Time:** 25 min **Temperature:** 80 °C

Figure 8: Recipe 2 made by Software for Sustainable

3.2.2.8 EIM Score for Sustainable in Recipe 2

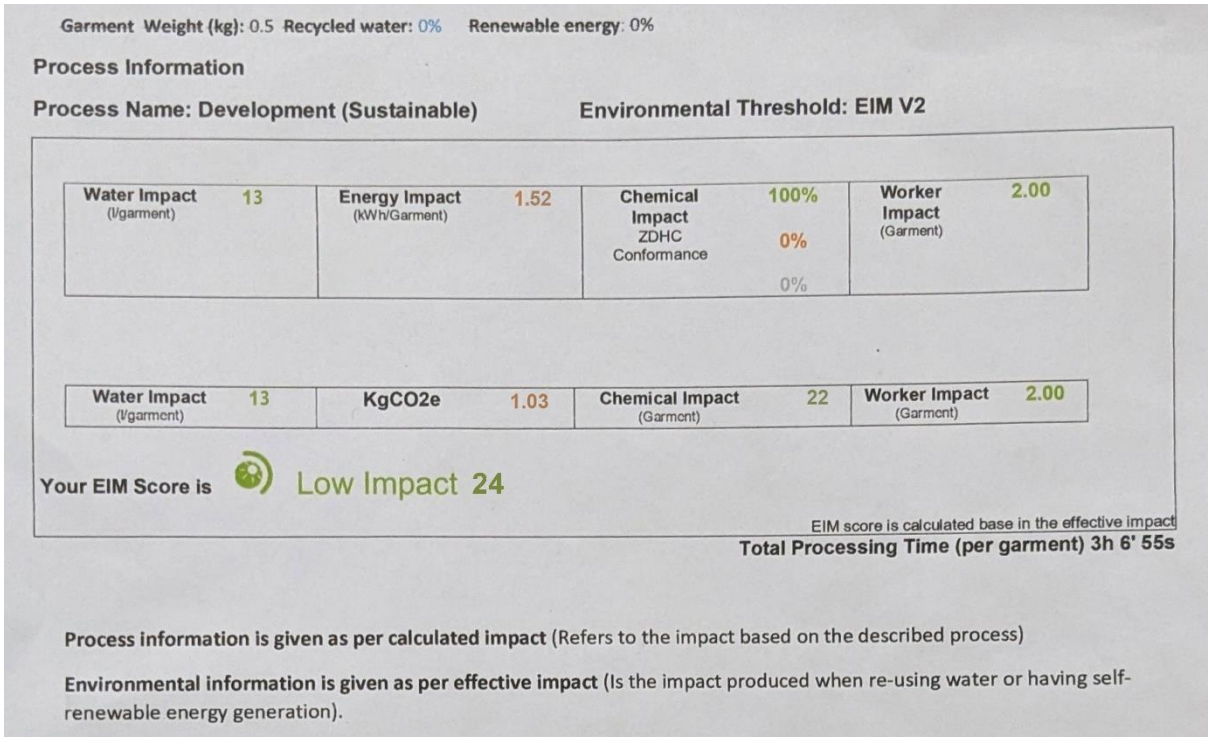


Figure 9: EIM Score for sustainable in Recipe 2

3.2.2.9 Conventional and Sustainable Environment Impact in Recipe 2

Table 14: Conventional and Sustainable Environment Impact in Recipe 2

Method	Weight	Water (L)	Energy (KWh)	Chemical (gm)	Chemical (%)	KgCO2e	Worker	EIM Score
Conventional Environment Threshold	0.5 kg	39 L	1.20	200 gm	71 %	0.47	100	72
Sustainable Environment Threshold	0.5 kg	13	1.52	50 gm	22 %	1.03	2	24

3.2.2.10 Total Water and Chemical Saving in Recipe 2

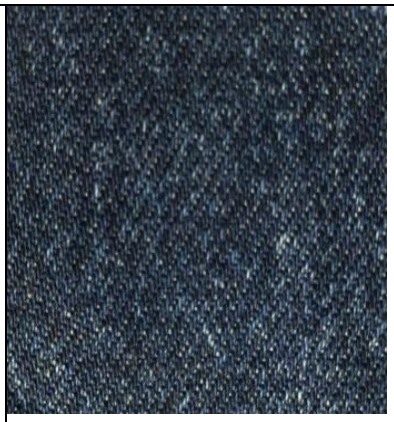
Table 15: Total Water and Chemical Saving in Recipe 2

Amount of water saving (L)	Water Saving (%)	Amount of Energy saving (%)	Amount of Chemical saving (%)	Total Chemical Saving (gm)	KgCO2e	Worker	EIM
23.5 L	66.66 %	6.9%	75%	150 gm	-4.1%	98 %	66%

3.2.2.11 Swatch Compare Between Sustainable & Conventional

Table 16: Swatch Compare Between Sustainable & Conventional Recipe 2

Process Name	**Conventional Wash 3**	**Process Name**	**Sustainable Wash 4**
Unwashed		Unwashed	
Desizing		Pre-Ozone (50%)	

Enzyme Wash		E flow Enzyme	
Denim Bleaching		Ozone fading (40%)	
Softening		E flow Softening	

3.2.3 Recipe 3 for Conventional and Sustainable

3.2.3.1 Data Table Conventional

Table 17: Recipe 3 for Conventional

Desizing

Operation	L: R	Water Liter	Temp ℃	Time Min	Dose G/L %	Chemical Name	Total Quantity
Insert Product	1: 6	3 L	50℃	10	3.00%	Eco size CLD 100GS	15 gm
					2.00%	Anti-Back Staining	10 gm
Drain							
Rinse	1: 6	3 L	25℃	2			
Drain							

Enzyme Wash

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 6	3 L	50℃	50	5.00%	Enzyme (Cellulase)	25 gm
						2.00%	Anti-Back Staining	10 gm
02	Drain							
03	Rinse	1: 6	3 L		2			
04	Drain							

Denim Bleaching

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 8	4 L	50℃	20	9.00%	Sodium Hypochlorite	45 gm
02	Drain							
03	Rinse	1: 6	3 L	25℃	2			
04	Drain							

Hydro Extractor: Time: 3 min RPM: 200

Chlorine Neutralization

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 6	3 L	45℃	5		2.00%	Sodium Meta Sulphate	10 gm
02	Drain								
03	Rinse	1: 6	3 L	25℃	2				
04	Drain								

Hydro Extractor: Time :5min RPM: 200

Dryer: Time:25min, Temparature:80℃

PP Spray

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product				30 Sec		Potassium Permanganate	5gm/L
							Phosphoric acid	3gm/L

PP Neutralization

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	45℃	5	2.00%	Sodium Meta Bi Sulphite	10 gm
						2.00%	Anti-Back Staining	10 gm
02	Drain							
03	Rinse	1: 6	3 L	40℃	2			
04	Drain							

Cleaning									
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2 L	50℃	10		2.00%	Soda Ash	10 gm
							2.00%	Hydrogen peroxide	10 gm
							1.00%	Anti-back Staining	5 gm
02	Drain								
03	Rinse	1: 6	3 L	25℃	2				

Softening									
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 6	3 L	45℃	10		12 %	Cationic Softener	60 gm
02	Drain								
03	Rinse	1: 6	3 L	25℃	2				
04	Drain								

Hydro: Time :5Min RPM: 200

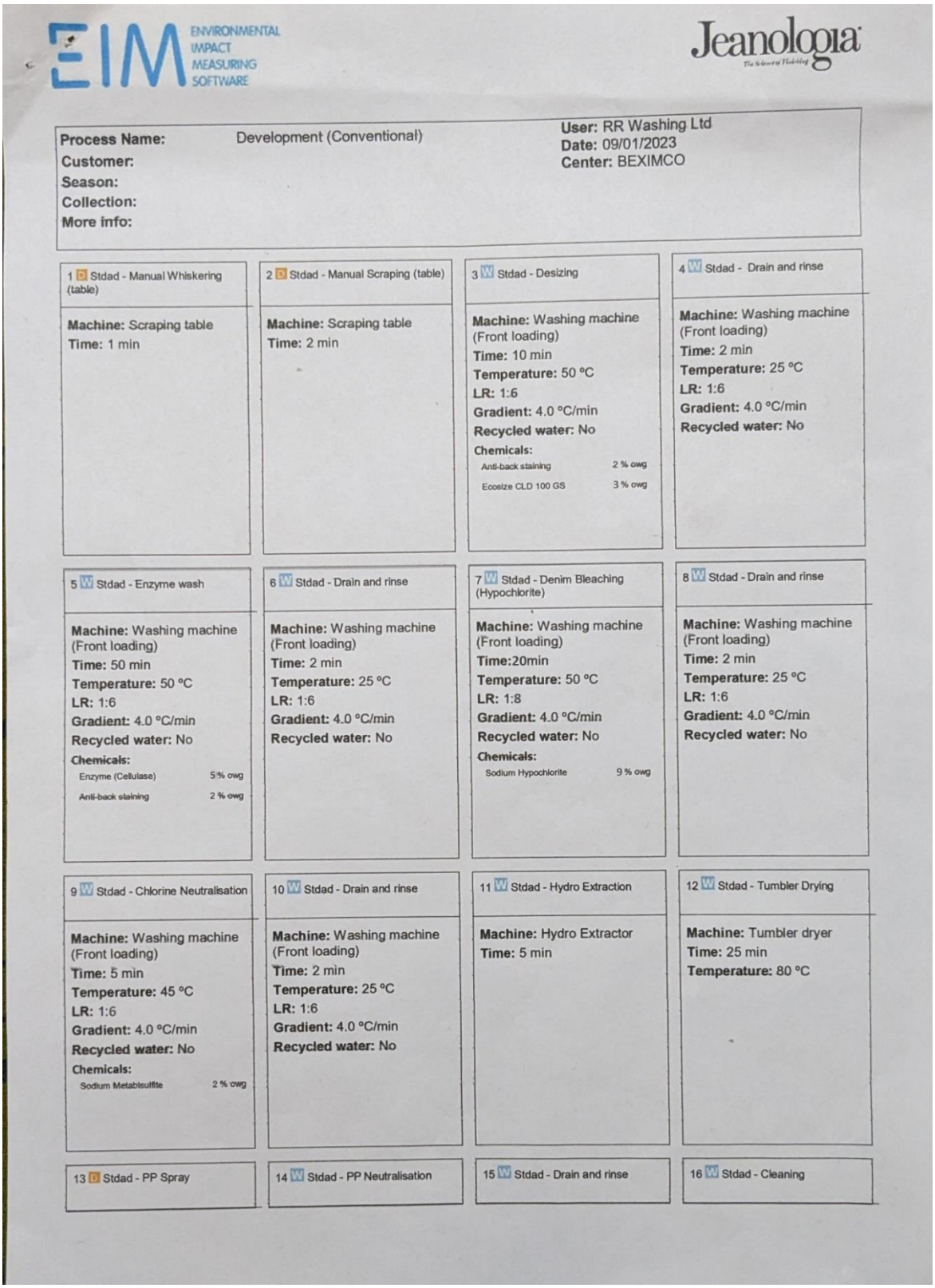
Dryer: Time:25Min, Temperature: 80℃

3.2.3.2 Dry Process in Conventional

Table 18: Dry Process in Conventional Recipe 3

Dry process		
Process name	Time	Manpower
Whisker	2min	4
Hand Scraping	2 min	2
PP spray	1min	3

3.2.3.3 Recipe 3 made by Software for Conventional



EIM ENVIRONMENTAL IMPACT MEASURING SOFTWARE

Jeanologia

Process Name: Development (Conventional)
Customer:
Season:
Collection:
More info:

User: RR Washing Ltd
Date: 09/01/2023
Center: BEXIMCO

1 D Stdad - Manual Whiskering (table)

Machine: Scraping table
Time: 1 min

2 D Stdad - Manual Scraping (table)

Machine: Scraping table
Time: 2 min

3 W Stdad - Desizing

Machine: Washing machine (Front loading)
Time: 10 min
Temperature: 50 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Anti-back staining 2 % owg
Ecosize CLD 100 GS 3 % owg

4 W Stdad - Drain and rinse

Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

5 W Stdad - Enzyme wash

Machine: Washing machine (Front loading)
Time: 50 min
Temperature: 50 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Enzyme (Cellulase) 5 % owg
Anti-back staining 2 % owg

6 W Stdad - Drain and rinse

Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

7 W Stdad - Denim Bleaching (Hypochlorite)

Machine: Washing machine (Front loading)
Time:20min
Temperature: 50 °C
LR: 1:8
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Sodium Hypochlorite 9 % owg

8 W Stdad - Drain and rinse

Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

9 W Stdad - Chlorine Neutralisation

Machine: Washing machine (Front loading)
Time: 5 min
Temperature: 45 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No
Chemicals:
Sodium Metabisulfite 2 % owg

10 W Stdad - Drain and rinse

Machine: Washing machine (Front loading)
Time: 2 min
Temperature: 25 °C
LR: 1:6
Gradient: 4.0 °C/min
Recycled water: No

11 W Stdad - Hydro Extraction

Machine: Hydro Extractor
Time: 5 min

12 W Stdad - Tumbler Drying

Machine: Tumbler dryer
Time: 25 min
Temperature: 80 °C

13 D Stdad - PP Spray

14 W Stdad - PP Neutralisation

15 W Stdad - Drain and rinse

16 W Stdad - Cleaning

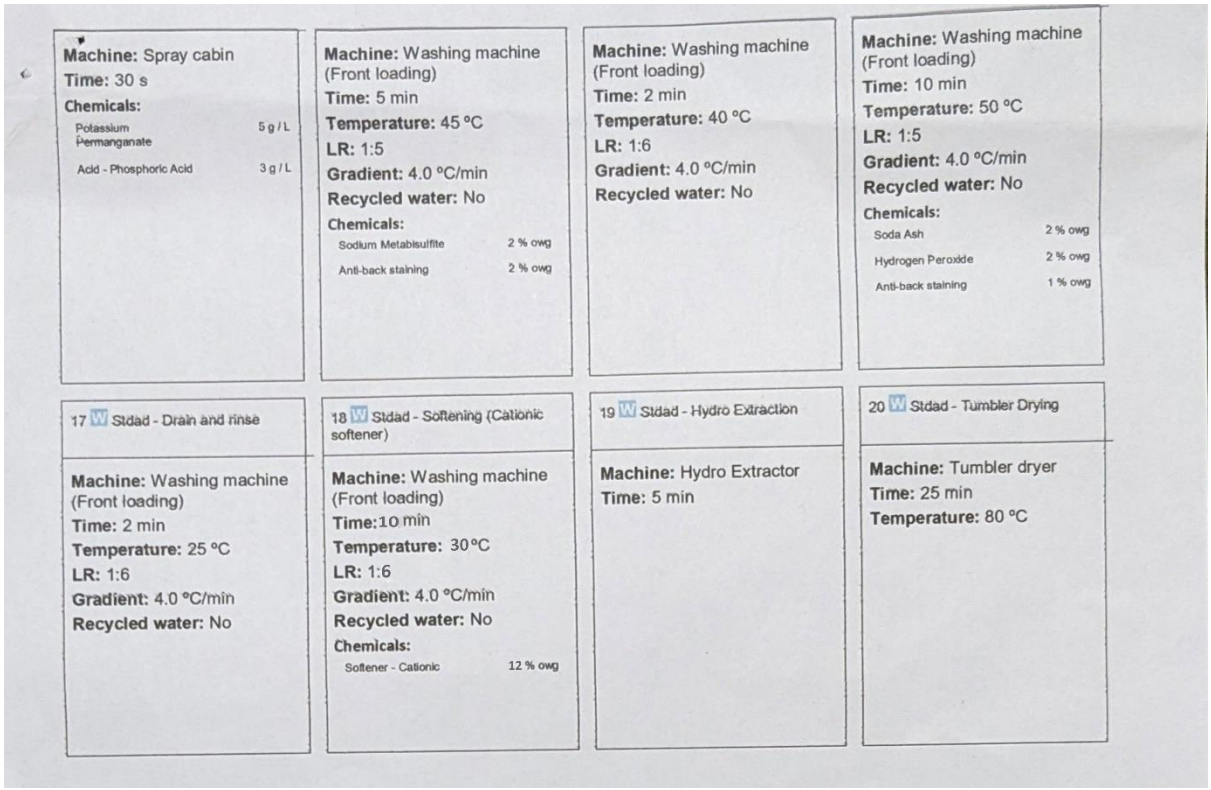


Figure 10: Recipe 3made by Software for Conventional.

3.2.3.4 EIM Score for Conventional in Recipe 3

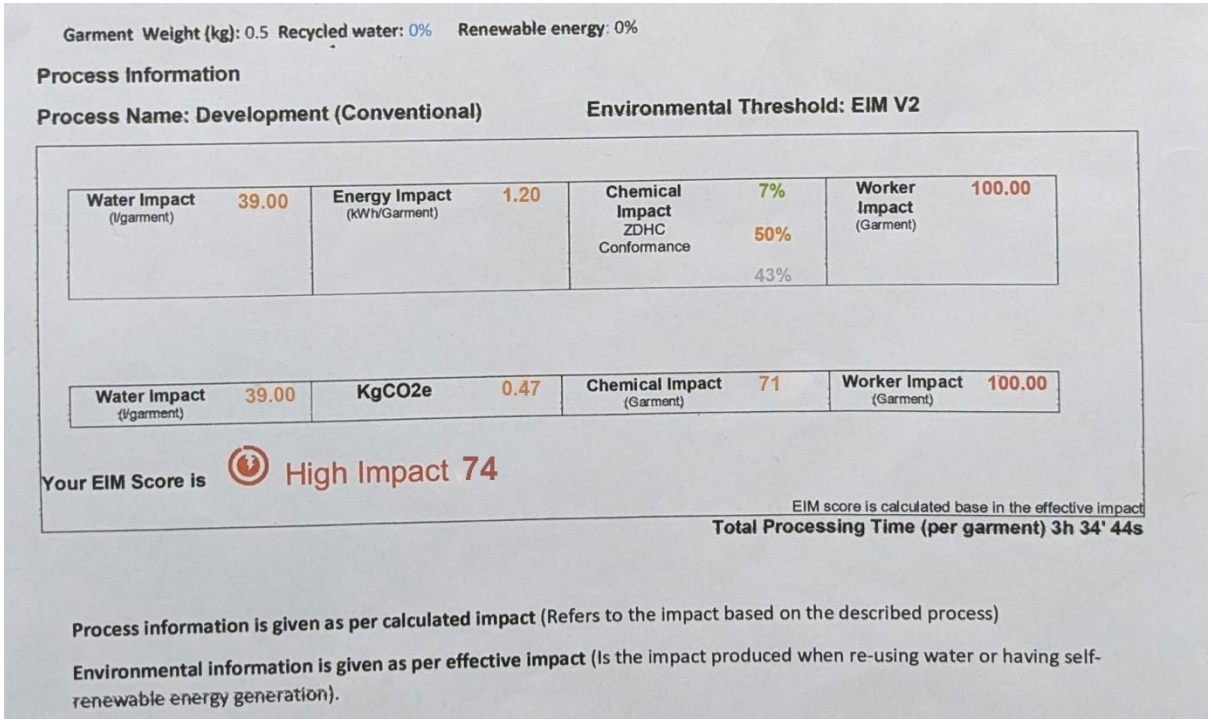


Figure 11: EIM Score for Conventional in Recipe 3

3.2.3.5 Data Table for Sustainable

Table 19: Recipe 3 (Sustainable)

Pre-Ozone (50%)

Operation	L: R	Water Liter	Temp ℃	Time Min	Dose G/L %	Chemical Name	Total Quantity
Insert Product	Dry Garment			15		50% Ozone	
Hot Rinse	1: 5	2 L	40℃	2			

E flow Enzyme

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 0.5	0.25 L	25℃	45	4 %	ATB 710	20 gm
02	Drain							
03	Hot Rinse	1: 5	2 L	45℃	2			
04	Drain							

Hydro Extractor: Time: 3 min RPM: 200

Ozone fading (40%)

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	Wet garments			20 min				

Bio Polishing

SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	PH	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 5	2.5 L	40℃	10		3 %	Sokostone NLC	15 gm
02	Drain								
03	Rinse	1: 5	2.5 L	40℃	2				
04	Drain								

Hydro: Time: 5 min RPM:200

Dryer: Time:25 min, Temperature: 80℃

E flow Softening								
SL.NO	Operation	L: R	Water Liter	Temp C	Time Min	Dose G/L %	Chemical Name	Total Quantity
01	Insert Product	1: 0.5	0.25 L	25℃	12	6 %	Lava Soft EPS	30 gm
02	Drain							
03	Rinse	1: 6	3 L	℃	2			
04	Drain							

Hydro: Time: 5 min RPM:200

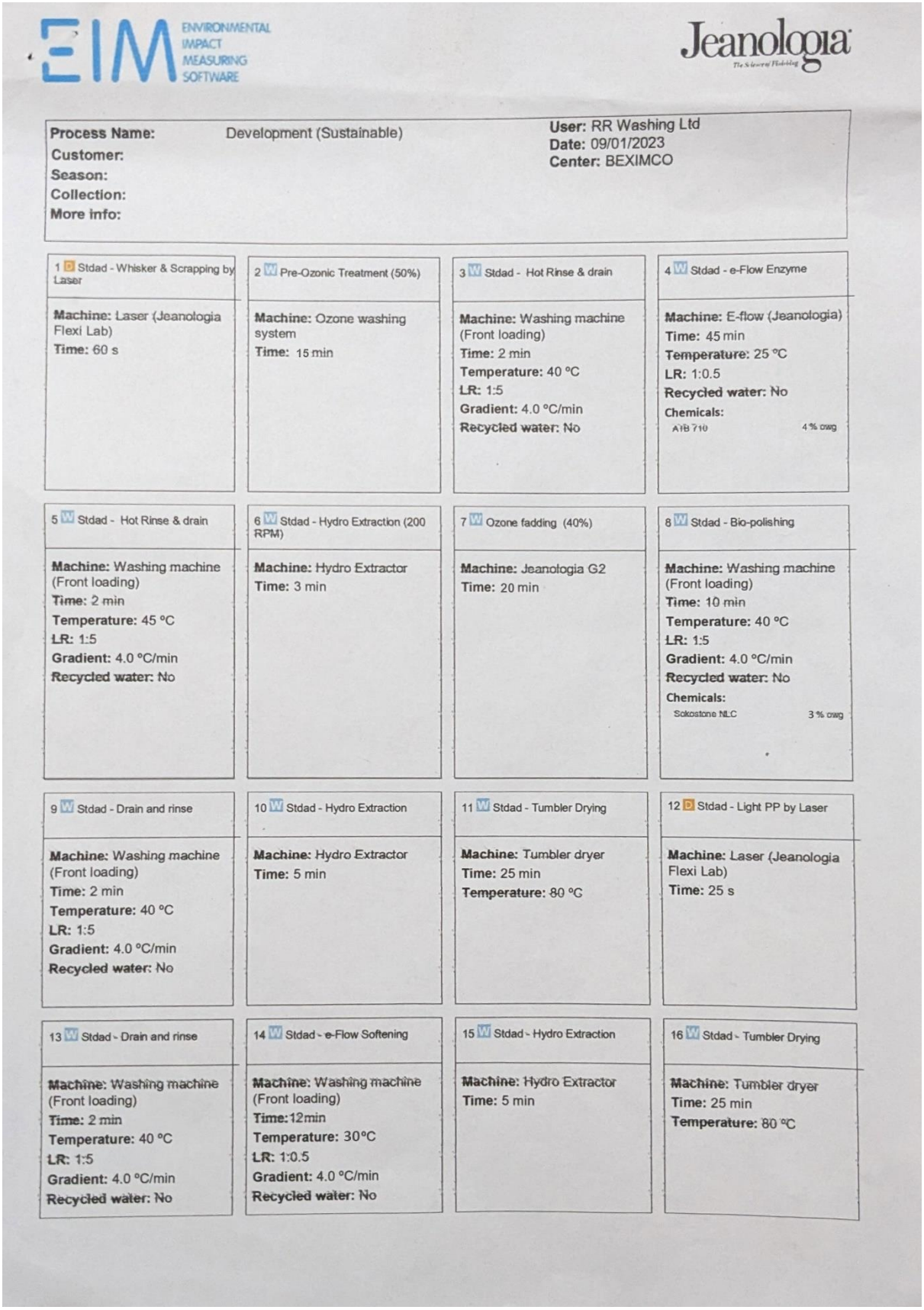
Dryer: Time:25 min, Temperature: 80℃

3.2.3.6 Dry Process in Sustainable

Table 20: Dry Process in Sustainable Recipe 3

Dry process		
Process name	Time	Manpower
Laser Whisker	1min	1
Scarping	1min	

3.2.3.7 Recipe 3 made by Software for Sustainable



EIM ENVIRONMENTAL IMPACT MEASURING SOFTWARE

Jeanologia

Process Name: Development (Sustainable)
Customer:
Season:
Collection:
More info:

User: RR Washing Ltd
Date: 09/01/2023
Center: BEXIMCO

1 D Stdad - Whisker & Scrapping by Laser **Machine:** Laser (Jeanologia Flexi Lab) **Time:** 60 s	2 W Pre-Ozonic Treatment (50%) **Machine:** Ozone washing system **Time:** 15 min	3 W Stdad - Hot Rinse & drain **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	4 W Stdad - e-Flow Enzyme **Machine:** E-flow (Jeanologia) **Time:** 45 min **Temperature:** 25 °C **LR:** 1:0.5 **Recycled water:** No **Chemicals:** ATB 710 4 % owg
5 W Stdad - Hot Rinse & drain **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 45 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	6 W Stdad - Hydro Extraction (200 RPM) **Machine:** Hydro Extractor **Time:** 3 min	7 W Ozone fadding (40%) **Machine:** Jeanologia G2 **Time:** 20 min	8 W Stdad - Bio-polishing **Machine:** Washing machine (Front loading) **Time:** 10 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No **Chemicals:** Sokostone NLC 3 % owg
9 W Stdad - Drain and rinse **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	10 W Stdad - Hydro Extraction **Machine:** Hydro Extractor **Time:** 5 min	11 W Stdad - Tumbler Drying **Machine:** Tumbler dryer **Time:** 25 min **Temperature:** 80 °C	12 D Stdad - Light PP by Laser **Machine:** Laser (Jeanologia Flexi Lab) **Time:** 25 s
13 W Stdad - Drain and rinse **Machine:** Washing machine (Front loading) **Time:** 2 min **Temperature:** 40 °C **LR:** 1:5 **Gradient:** 4.0 °C/min **Recycled water:** No	14 W Stdad - e-Flow Softening **Machine:** Washing machine (Front loading) **Time:** 12 min **Temperature:** 30 °C **LR:** 1:0.5 **Gradient:** 4.0 °C/min **Recycled water:** No	15 W Stdad - Hydro Extraction **Machine:** Hydro Extractor **Time:** 5 min	16 W Stdad - Tumbler Drying **Machine:** Tumbler dryer **Time:** 25 min **Temperature:** 80 °C

Figure 12: Recipe 3 made by Software for Sustainable

3.2.3.8 EIM Score for Recipe 3

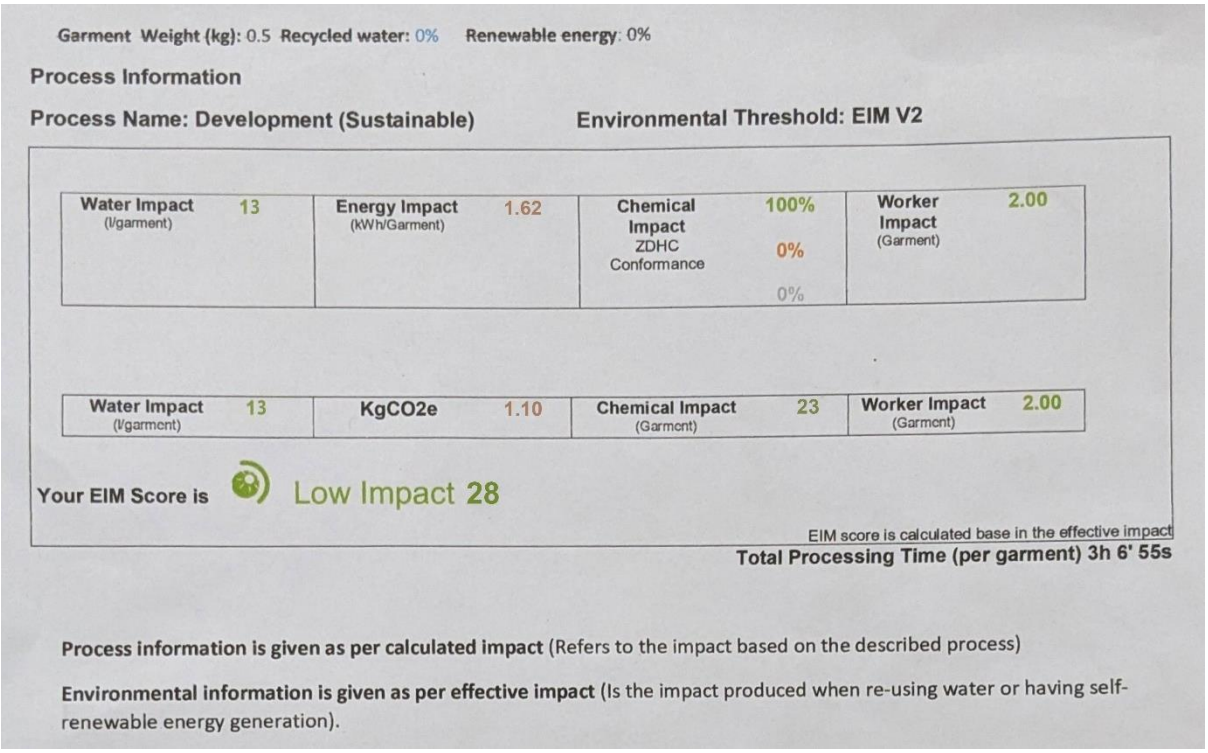


Figure 13: Sustainable EIM Score in Recipe 3

3.2.3.9 Conventional and Sustainable Environment Impact in Recipe 3

Table 21: Conventional and Sustainable Environment Impact in Recipe 3

Method	Weight	Water (L)	Energy (KWh)	Chemical (gm)	Chemical (%)	KgCO2e	Worker	EIM Score
Conventional Environment Threshold	0.5 kg	39.5 L	1.28	230 gm	73 %	0.49	100	74
Sustainable Environment Threshold	0.5 kg	13	1.62	65 gm	23 %	1.10	2	28

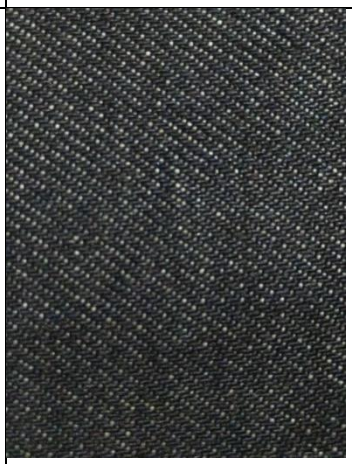
3.2.3.10 Total Water and Chemical Saving in Recipe 3

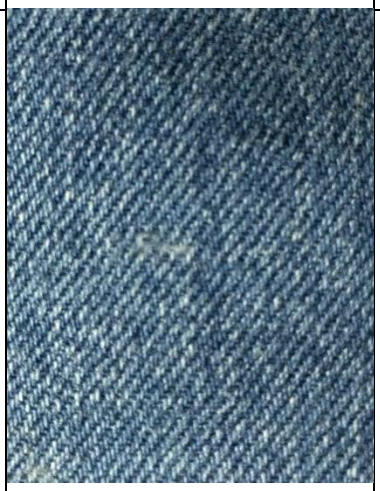
Table 22: Total Water and Chemical Saving in Recipe 3

Amount of water saving (L)	Water Saving (%)	Amount of Energy saving (%)	Amount of Chemical saving (%)	Total Chemical Saving (gm)	KgCO2e	Worker	EIM
23.5 L	67 %	7%	71.7%	165 gm	-4.4%	98 %	62%

3.2.3.11 Swatch Compare Between Sustainable & Conventional

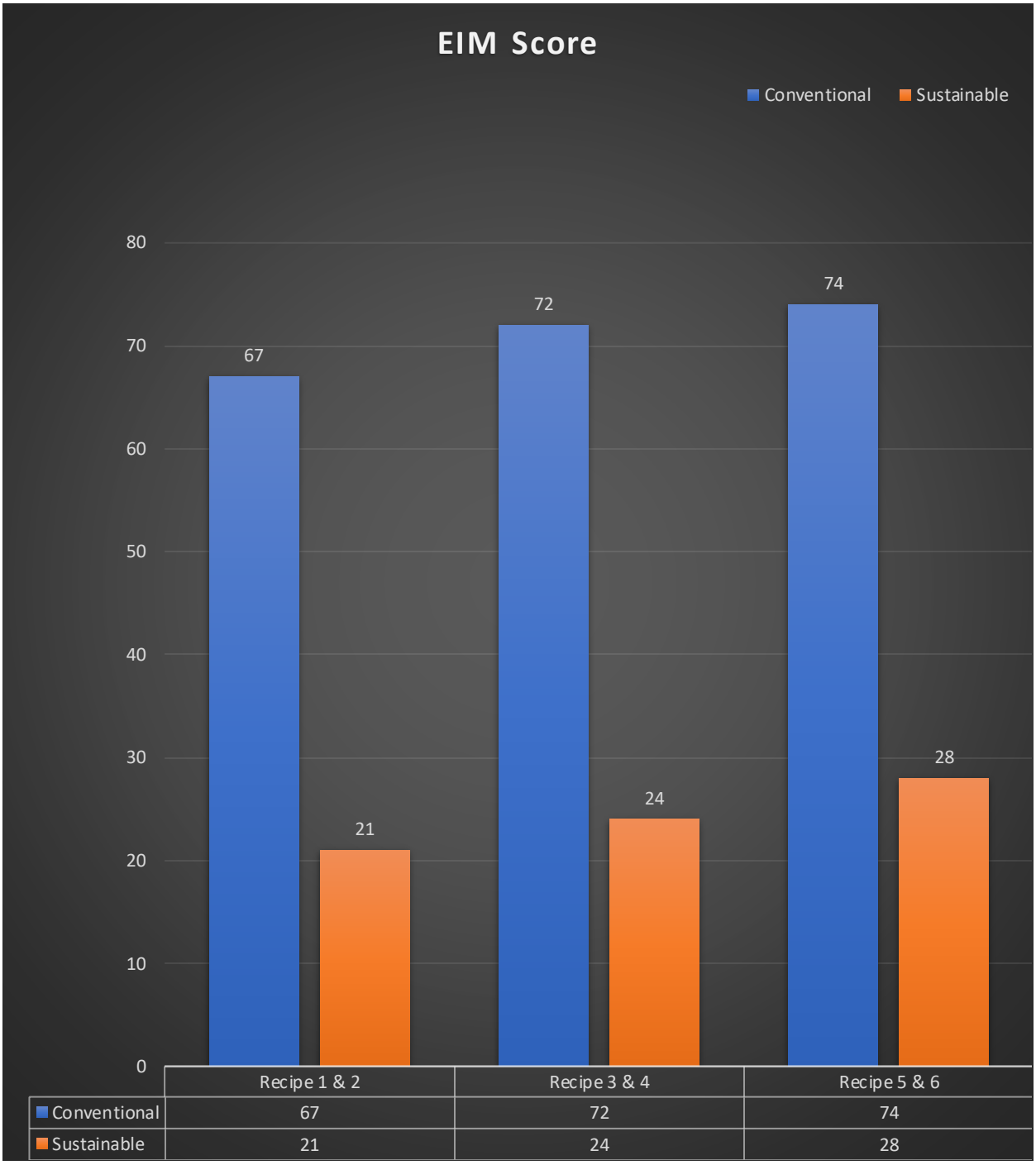
Table 23: Swatch Compare Between Sustainable & Conventional Recipe 3

Process Name	**Conventional Wash**	**Process Name**	**Sustainable Wash**
Unwashed garment		Unwashed Garment	
Desizing		Pre-Ozone (50%)	

Enzyme Wash		E flow Enzyme	
Denim Bleaching		Ozone fading (40%)	
Softening		E flow Softening	

CHAPTER-4 RESULT AND DISCUSSION

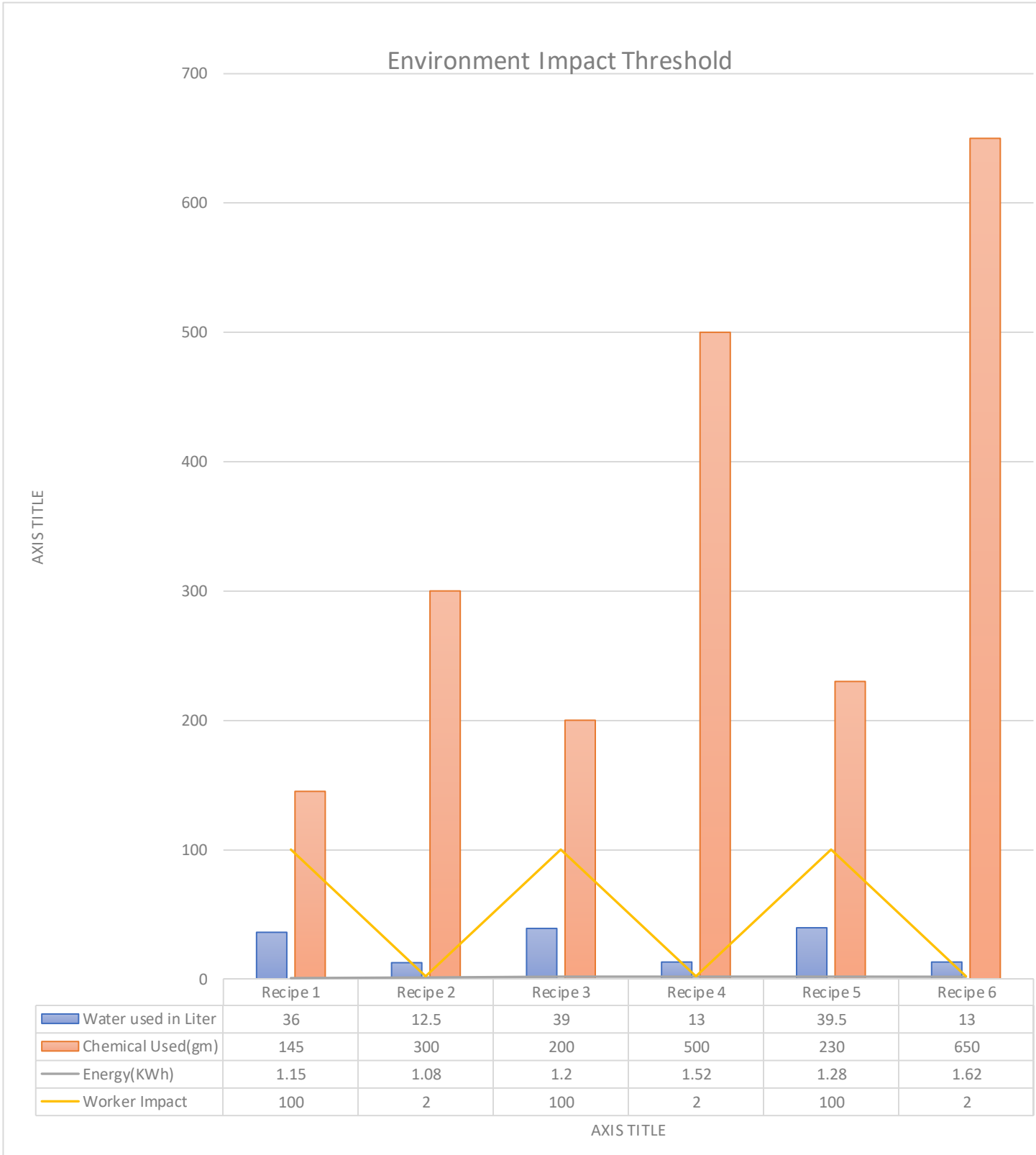
4.1 Analyze After Changing Different Parameter



Graph 1: EIM Score Change in Parameter After Changing Different Parameter

Here we can see sustainable score always be lower than conventional. In conventional recipe 5, the EIM score is the highest and that is 74. Recipe 2 is the lowest that is 21 and it is sustainable recipe.

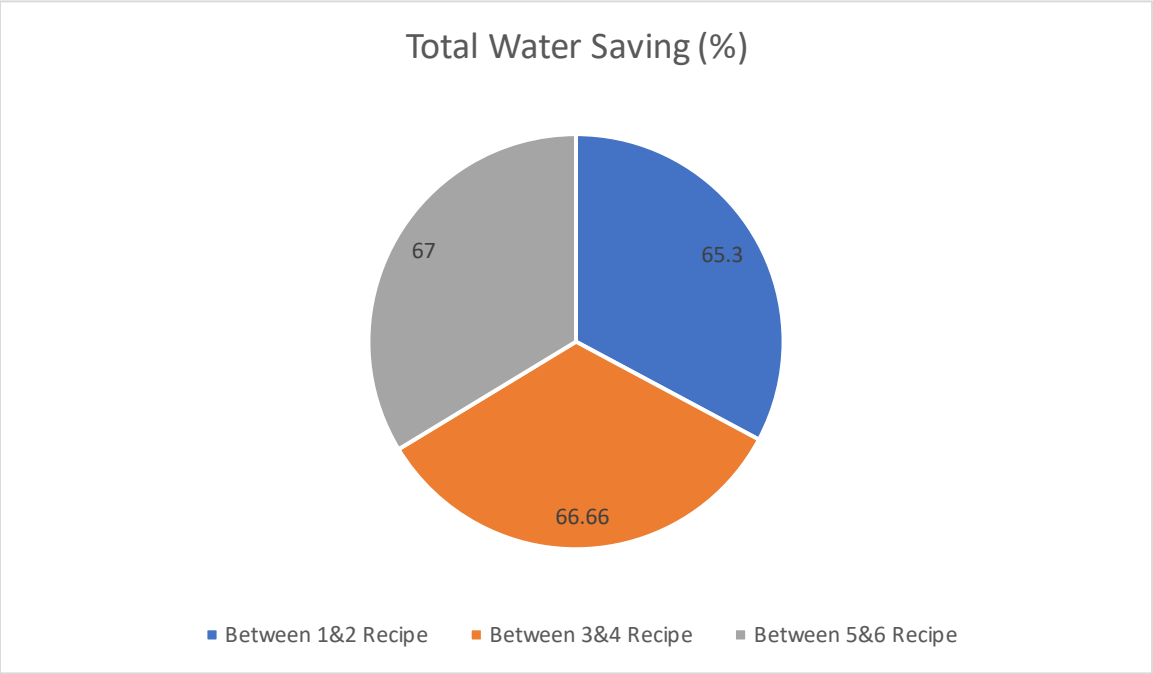
4.2 Environment Impacts Threshold Shown in Graph



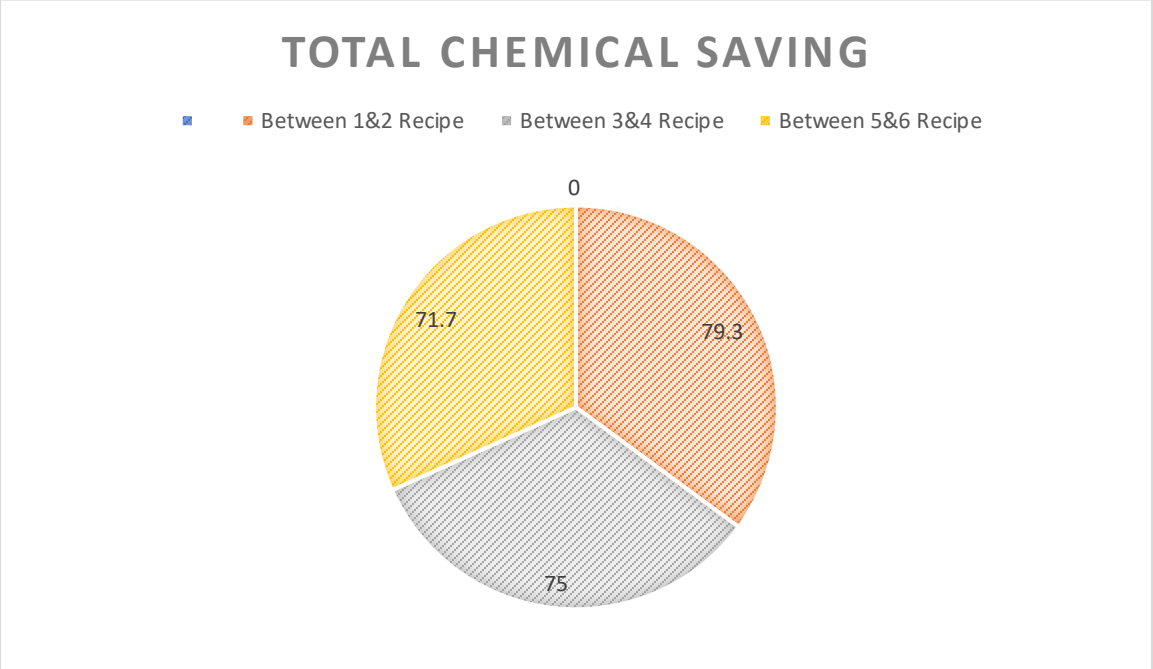
	Recipe 1	Recipe 2	Recipe 3	Recipe 4	Recipe 5	Recipe 6
Water used in Liter	36	12.5	39	13	39.5	13
Chemical Used(gm)	145	300	200	500	230	650
Energy(KWh)	1.15	1.08	1.2	1.52	1.28	1.62
Worker Impact	100	2	100	2	100	2

Graph 2: Environment Impact Threshold Shown in Graph

4.3 Total Water & Chemical Saving (%)

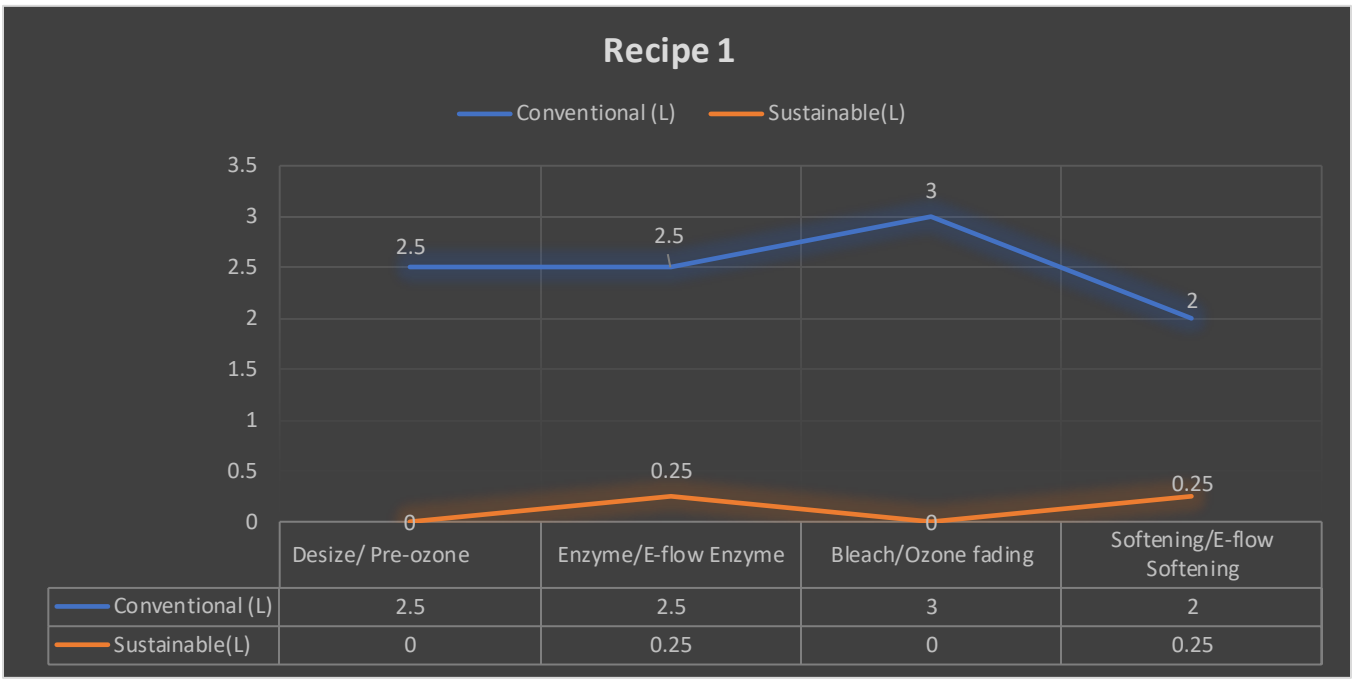


Graph 3: Total Water Saving (%)

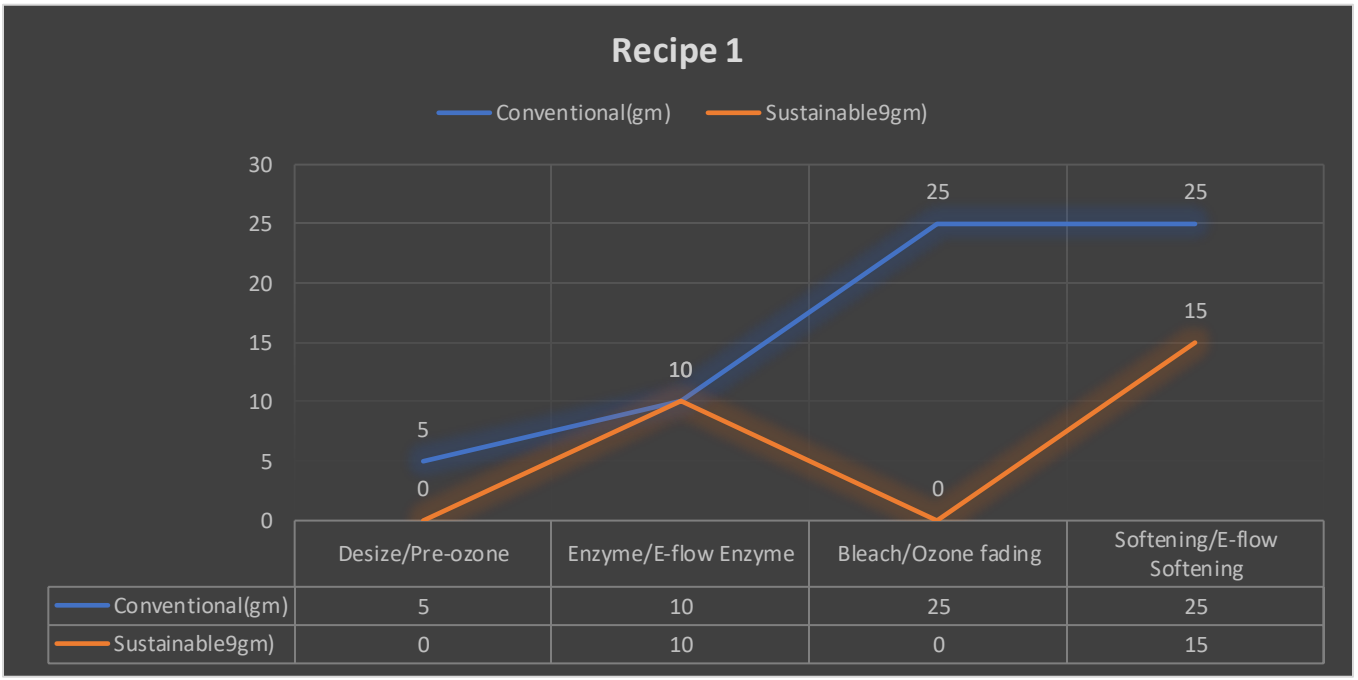


Graph 4: Total Chemical Saving (%)

4.4 Liquor Ratio & Chemical Used in Different Process

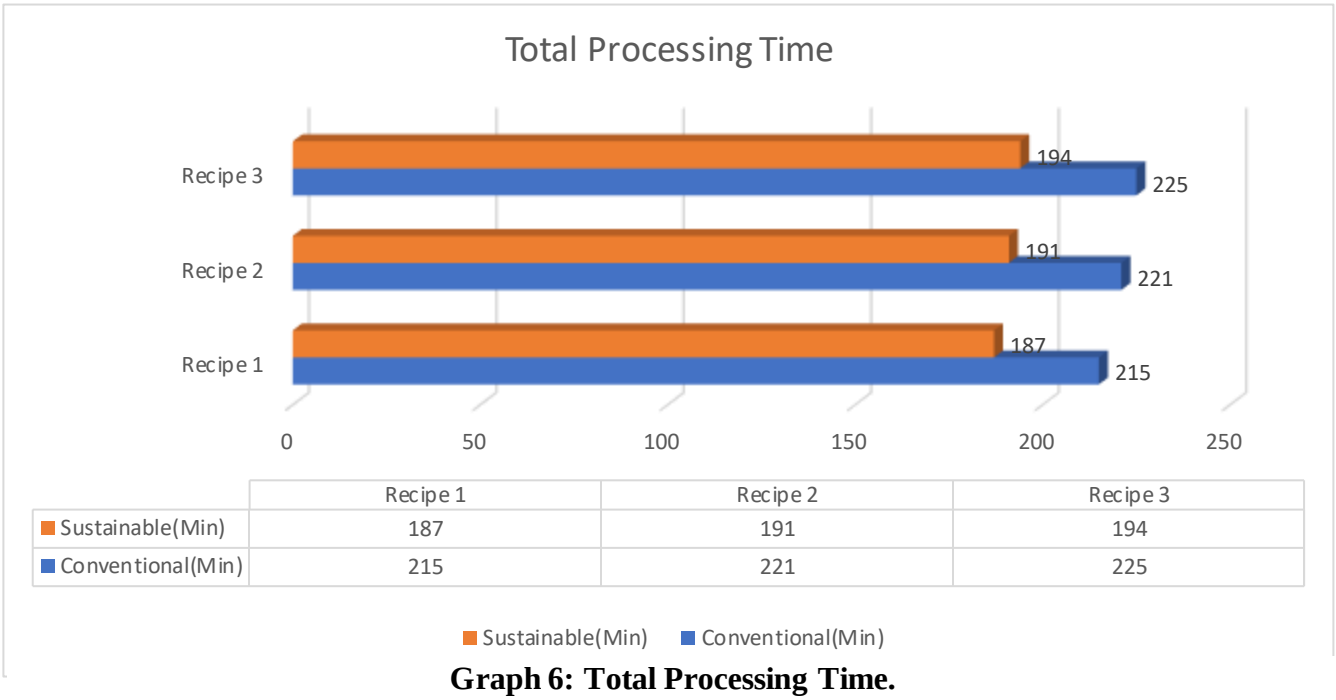


Graph 5: Liquor ratio used in different process between Conventional and Sustainable recipe 1



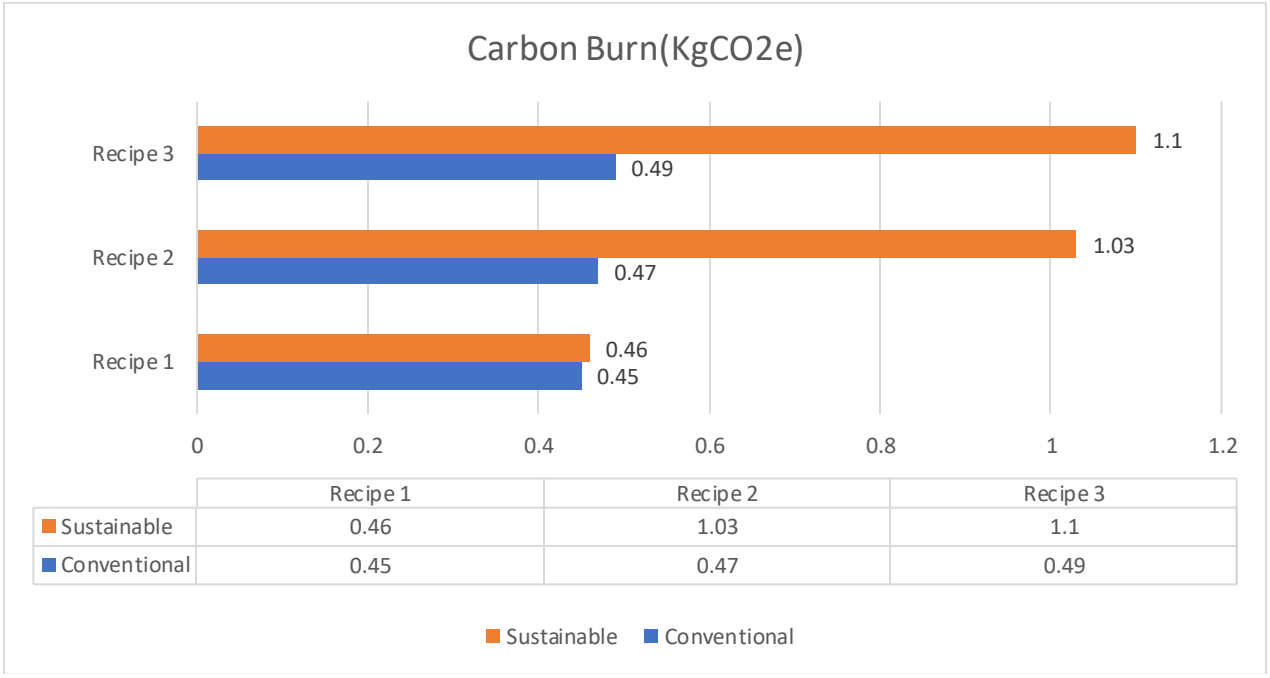
Graph 5: Chemical used in different process between Conventional and Sustainable recipe 1

4.5 Total Processing Time & Total Carbon Burn(kgCO2e)



	Recipe 1	Recipe 2	Recipe 3
Sustainable(Min)	187	191	194
Conventional(Min)	215	221	225

Graph 6: Total Processing Time.



	Recipe 1	Recipe 2	Recipe 3
Sustainable	0.46	1.03	1.1
Conventional	0.45	0.47	0.49

Graph 7: Total Carbon burn *KgCO2e*

KgCO2e is the unit carbon footprints are often measured in and it translates to Kilograms of carbon Dioxide equivalent.

Chapter 5: Professional Responsibilities, Health, Safety, Socio-cultural and Environment Consideration

5.1 Codes and Standards Used:

There are several codes and standards related to the washing industry, including:

ISO 6330: This standard specifies methods for testing the colorfastness and dimensional stability of textile fabrics that are intended to be washed.

ASTM D3775: This standard provides methods for testing the breaking strength and elongation of textile fabrics that are intended to be washed.

AATCC 61: This test method is used to determine the resistance of fabrics to the growth of mildew when subjected to conditions of high humidity and temperature.

NFPA 96: This standard provides requirements for the design, installation, operation, inspection, and maintenance of commercial cooking operations, including exhaust hoods, grease filters, and ductwork.

ANSI/AHAM HFS-2: This standard provides guidelines for the performance and safety of home laundry appliances, including washing machines, clothes dryers, and combination washer-dryers.

In addition to these standards, there may be local, state, and national codes and regulations that apply to the washing industry, depending on the location and type of facility. It's important for businesses in the washing industry to be aware of these standards and regulations to ensure compliance and promote safety and quality.

5.2 Ethical principle and professional commitment:

- Willing to choose the job freely
- Unity to have free association.
- Work place safety and healthy environment.
- No child Labor.
- Minimum wage for living
- Working hour Should not more
- No discrimination
- Regular Job availability
- No Inhumanity Behavior to worker

5.3 Impact on society, health, safety, legal and cultural issue:

Sustainable Washing process:

Sustainable washing practices can have a wide range of impacts on society, health, safety, legal, and cultural issues. Here are a few examples:

Society: Sustainable laundry practices help promote environmental protection and conserve natural resources for future generations.This helps foster a sense of responsibility and accountability for the environment, making it more sustainable and resilient It may lead to a community with

Health: Sustainable laundry practices help reduce exposure to harmful chemicals that can have a positive impact on public health. , help reduce the incidence of respiratory and skin diseases, promote healthy indoor air quality, and reduce exposure to harmful substances.

Safety: Sustainable washing practices can help to reduce the risk of accidents and injuries. For instance, using water-efficient washing machines and ensuring proper installation and maintenance of washing equipment can help to prevent water leaks and flooding, which can pose safety risks to people and property.

Legal: Adherence to environmental, health, and safety regulations is a legal requirement for businesses in the washing industry. Sustainable washing practices can help to ensure compliance with these regulations, avoiding legal penalties and fines.

Cultural: Sustainable laundry practices help promote cultural values that emphasize the importance of environmental protection and social responsibility. By committing to sustainable practices, companies in the laundry industry can build a positive reputation with consumers and stakeholders and help develop a culture of sustainability and responsibility.

In summary, sustainable laundry practices can have a positive impact on social, health, safety, legal, and cultural issues. By adopting these practices, companies in the laundry industry will become more You can contribute to a sustainable, healthy, and responsible future.

5.4 Impact on Environment:

- Sustainable washing processes can have a positive impact on the environment in several ways:
- Reduced water consumption: Sustainable washing processes typically use water-efficient washing machines, which require less water to operate. This can help to conserve water resources and reduce the strain on water systems, particularly in areas with water scarcity.
- Reduced energy consumption: Sustainable washing processes often use energy-efficient washing machines and reduce energy consumption, thereby reducing greenhouse gas emissions and contributing to the fight against climate change.
- Use of eco-friendly detergents: Sustainable washing processes typically use eco-friendly detergents that are free from harmful chemicals, reducing the release of pollutants into the environment.
- Reduced waste: Sustainable washing processes aim to reduce waste by using and reusing materials, such as washable clothing and towels, and recycling or properly disposing of waste.
- Reduced environmental pollution: Sustainable washing processes can reduce the environmental pollution caused by washing, such as the release of pollutants into waterways and the emission of greenhouse gases.
- By adopting sustainable washing processes, individuals and businesses can contribute to a more sustainable and eco-friendly future, promoting environmental conservation and reducing the impact of washing on the environment

CHAPTER 6: CONCLUSION

Jeans will be used to complete this research. Jean's composition (70% cotton, 28% polyester, 2% Spandex). Due to the presence of Lycra in the fabric, shrinkage increased in both the warp and weft directions, but the shrinkage in the warp direction was higher than the shrinkage in the warp direction. rise. This project presents the denim sector and future denim processes (sustainable washing processes) and traditional processes. We compare these processes and test several processes (such as tear strength, tensile strength, GSM.EPI, and PPI). Our world is polluted daily. Denim pollutes our environment badly, but we make a lot of money in the denim sector. That's why we need to wash our denim a sustainable way, and it's good for both us and the environment. For this reason, we seek to explain sustainable denim washing and its processes, as well as their implications for the times to come. Finally, I have to say that the future of denim in our country is very bright. To develop further, we must take a sustainable path.

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