

# LASER AND MANUAL WHISKER WITH SCRAPPING PROCESS ANALYSIS IN TERMS OF INDUSTRIAL ENGINEERING AND SUSTAINABILITY FOR DENIM WASHING INDUSTRIES

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**Abstract:** Whisker and scrapping is a well-known dry process in the denim washing industry. Whisker is the worn-out lines and impression patterns generated by natural wearing on hips and front thigh area. On the other hand, to create a distressed look hand scrapping is applied on the front thigh, upper back knee, upper pocket side, or overall area of a denim garment. Nowadays those are common dry processes for denim wash. Those are used to increase the fashionable look of a denim garment. Whisker and scrapping are the first process of the denim dry process. There are many types of whisker and scrapping process for denim garments. In the manual version generally, it is done by pattern, chalk, and emery paper. Another popular and well-established way is laser burning. Both process is well qualified to meet consumer demand. The final outlook and outcome are also the same for both processes. But here the main issue is SMV, per-hour output, Manpower, and Sustainability. For manual processes, SMV is more and Per hour output is less as a result the production is less, and extra manpower is required. For manual scrapping PP spray process is required to increase the distress look. That's why this process is not sustainable for the application of potassium permanganate (PP Spray). For laser burning, the machine output is much higher for machine operation less manpower is required. And here the laser effect enhancing chemical is applied instead of PP spray which is a sustainable process. As a result, production must be higher for a washing plant by implementing a laser burning process instead of a manual process.

**Keywords:** dry process, potassium permanganate, SMV, sustainability, laser enhancing.

## ANALIZA LASERSKOG I RUČNOG STVARANJA EFEKATA BRKOVA I PROCESA STRUGANJA U POGLEDU INDUSTRIJSKOG INŽENJERSTVA I ODRŽIVOSTI ZA INDUSTRIJU PRANJA DENIMA

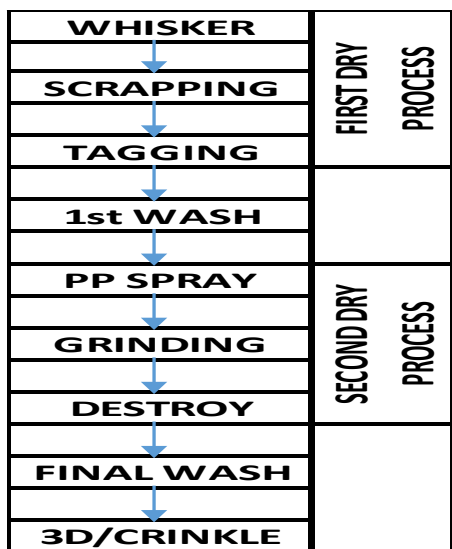
**Apstrakt:** Efekat brkova i struganje su dobro poznati suvi procesi u industriji oplemenjivanja teksasa. Efekat brkova su izluzane linije i utisci nastali prirodnim nošenjem na bokovima i prednjem delu butina. S druge strane, da bi se stvorio uznemiren izgled, oštećivanje se primenjuje na prednju butinu, gornji deo zadnjeg kolena, stranu gornjeg džepa ili celokupnu površinu teksas odeće. Danas su to uobičajeni procesi sušenja za pranje teksasa. Oni se koriste za povećanje modernog izgleda odeće od teksasa. Efekat brkova i struganje teksasa su prvi suvi procesi.

Postoji mnogo tipova efekata brkova i procesa kod odeće od teksasa. U ručnoj verziji uglavnom se to radi uzorkom, kredom i brusnim papirom. Još jedan popularan i dobro uspostavljen način je lasersko spaljivanje. Oba procesa su dobro kvalifikovana da zadovolje potražnju potrošača. Konačni izgled i ishod su takođe isti za oba procesa. Ali ovde je glavni problem SMV, proizvodnja po satu, radna snaga i održivost. Za ručne procese, SMV je veći i učinak po satu je manji, kao rezultat toga, proizvodnja je manja i potrebna je dodatna radna snaga. Za ručno rasipanje PP spreja potreban je postupak da bi se povećao izgled. Zbog toga ovaj proces nije održiv za primenu kalijum permanganata (PP sprej). Za lasersko sagorevanje, izlaz mašine je mnogo veći za rad mašine, potrebno je manje radne snage. I ovde se hemikalija za poboljšanje laserskog efekta primenjuje umesto PP spreja, što je održiv proces. Kao rezultat toga, proizvodnja mora biti veća za postrojenje za pranje primenom procesa laserskog sagorevanja umesto ručnog procesa.

**Ključne reči:** suvi proces, kalijum permanganat, SMV, održivost, lasersko oplemenjivanje.

### 1. INTRODUCTION

Whisker and scrapping are the first dry process which is done on raw unwashed denim garments. Whisker and scrapping are major ornamentations and eventually, those are the main requirements for all kinds of denim garments from short pants to long pants. It ensures the major vintage-looking requirements for consumers. Sometimes whiskers and scrapping are designed on jacket sleeves to make it more fashionable.



**Figure 1:** Denim Wash Basic Flow Chart

In most washing industries in Bangladesh manual Whisker and scrapping processes are very popular. In the manual Whisker process, there are two major ways of doing whisker in any kind of denim garment. Those are:

- a. By Pattern and manual operation
- b. By Chalk and Manual Operation.

A pattern is created by a pattern master on a rubber board by following the standard given by the buyer. Different sizes of patterns are created depending

on the different sizes of the same style of garments. Then the denim garments are placed perfectly on the pattern and the surface is rubbed with emery paper. Different kinds of emery papers are used depending on the intensity of the whisker as per buyer standards. This is the process termed as manual Whisker process by pattern. Another way is drawing the whisker lines on the garments by chalk then by using emery paper the operation is completed. But this is not that much popular & and efficient way of doing whiskers. For a small number of production & and sample development this process may be used. Generally, in Bangladesh, the manual operation is done on a scrapping table but a mannequin is also used as a scrapping pad or bed.

For manual scrapping, emery paper is used to rub the surface of raw denim garments as per buyer requirements.

Another well-known and first-growing whisker and scrapping process is laser burning. First, the Whisker or scrapping design some time both are made by Photoshop or Illustrator, and then the design is transferred to a laser machine. After that, the intensity of laser light is selected. Finally, laser light is imposed on the denim garments to get the design.

This paper is mainly based on the production output and SMV of both manual and laser whisker Processes. This article showed how SMV, cycle time and production changed and increased for the Laser Whisker process instead of the Manual Whisker process. And the sustainability of the whole process was also another parameter of this project [1-4].

### 2. EXPERIMENTAL

#### 2.1. Materials & metode

This experiment was done in a renowned washing plant in Bangladesh. Eight pieces of denim lady's short pants were taken from bulk production. Those



**Figure 1:** Lady's Denim Short Pant (Raw Garment)



**Figure 2:** 400 Grade Emery Paper (Left) Rubber Pattern Board (Middle) Manual whisker operation station (Right)

were processing for a famous brand in Europe. Four short pants were processed with manual whisker and scrapping process with a conventional wash procedure. Another four garments were trialed with a laser whisker and scrapped then washed with a sustainable recipe. The GSM of the fabric was 450 and it was 3/1 warp-faced constructed fabric by which the short pant was sewed.

**Manual Operation:** For Manual operation, a term is used set of operators. One or mostly two operators are assigned for one set of whisker or scrapping operations. One operator set is less popular because wastage of time and higher cycle time are the main drawbacks. But in the case of two operator sets one performs the left leg operation and another does the right leg. In this way, a lot of time is saved by minimizing material handling time. The output of the set depends on the cycle time, quality, and experience of the worker.

Or manual whisker operation, one set was designed by two skilled operators. A well-trained pattern master developed the whisker design as per the buyer's requirement and installed that on two scrapping pads. 400-graded emery paper was used for rubbing to create a whisker effect.



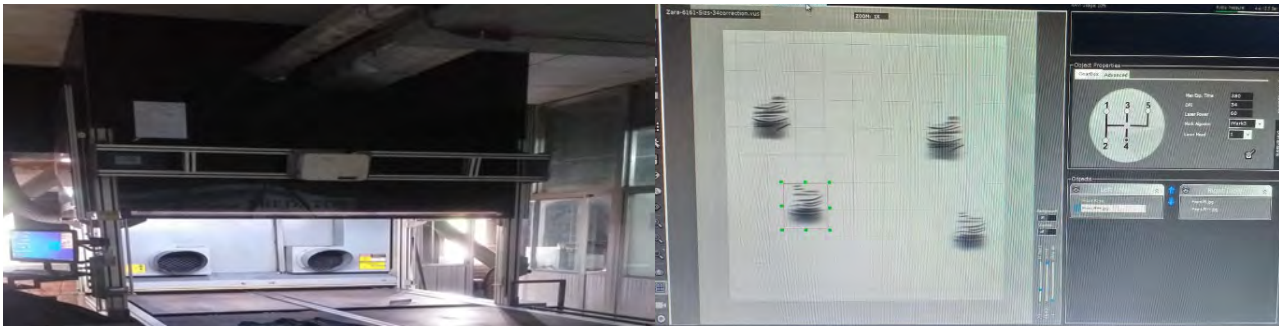
**Figure 3:** Manual Whisker Completed

After Whisker manual scrapping was done on a scrapping pad by using 320 Graded Emery paper. The scrapping was done with the buyer's desired intensity and effect. Here one set was designed of two skilled operators for this operation.

**Laser Burning Operation:** For laser whisker and Scrapping operation the Whisker or scrapping design was made by Photoshop or Illustrator, and then the design is transferred to a laser machine. Here VAV PREDATOR FX 4X(600W) Laser machine were used for completion of this task. After that, the intensity of laser light is selected. Finally, laser light is imposed on the denim garments to get the design.



**Figure 4:** 320 Grade Emery Paper (Left) Manual Scrapping Operation Station (Middle & Right)



**Figure 5:** Laser Machine (Left) The Design on Laser Machine Monitor (Right)



**Figure 6:** Laser Projector Alignment On garments



**Figure 7:** Laser Trialed Garments

## 2.2. Production Aanalysis

SMV (Standard Minute Value) is a very crucial term in industrial engineering. As per the ILO work study book Standard Minute is the time value arrived at for a task based on the average rate of output which qualified workers will naturally achieve without over-exertion provided that they know and adhere to the specified method and that they are motivated to apply themselves to their work.[5]

SMV is calculated to give a target for a process on an hourly, shift-wise, or daily basis. SMV simply depends on Cycle time and Obseved time.

$$\text{Observe Time} = (\text{Total Cycle Time} \div \text{Number of Cycles}) \text{ Seconds} \quad (1)$$

$$\text{SMV} = (\text{Observe Time With 5\% Allowance} \div 60) \text{ Minutes} \quad (2)$$

$$\text{Per Hour target} = (60 \div \text{SMV}) \text{ Pieces} \quad (3)$$

These formulas were used here for SMV and production analysis.

The analysis was done for bulk production. For Manual Operation total of four operators were involved in performing the full dry process. Two helpers were also recruited for feeding operations and helped the operators to perform their job smoothly.

### Production analysis for Manual Operation:

The chart below clearly shows that for manual whisker hourly target is 120 Pieces Per set of two operators.

For manual scrapping, the hourly target is 45 Pieces Per set of two operators. The cycle was taken by using a stopwatch and the SMV of each process was calculated by following the formulas.

### Production analysis for Laser Operation:

In the laser burning process, the total burning time was calculated to a given hourly target. Here burning time was considered as observed time for calculating SMV. Then 5% allowance was added to the burning time/Laser printing time. Then the SMV Was calculated and it was 0.41 and the hourly target was 146 Pieces. If we consider a 5% loss on the hourly target then the final hourly target should be 138 Pieces. Let us consider 135 Pieces. This was only one table production. The laser machine had two of them. That means per machine hourly output was 270 Pieces. Here only two operators were involved in production. One operator per one laser table.

**Table 1:** Manual Whisker and Scrapping SMV and Target Analysis

Name of the operation	Cycle Time (For Full Operation Left + Right Side)					Total Cycle Time	Obseved Time	Obseved Time With 5% Allowance	SMV	Per hour target
	1	2	3	4	5					
SI No.	1	2	3	4	5	143	29	30	0.50	120
Manual Whisker (Cycle in Sec)	30	27	28	27	31					
SI No.	1	2	3	4	5	378	76	79	1.32	45
Manual Scrapping (Cycle in Sec)	78	75	77	73	75					

- Average Target of both processes per set:  $(120+45) \div 2 \approx 85$  Pieces
- Average Target of both processes per Operator :  $(85 \div 2) \approx 43$  Pieces
- Manpower Involved: 4 Operators/ 2 helpers Total 6 persons.
- Shift output :  $(4 \times 43 \times 8) = 1360$  Pieces Approximately (Considering 8 Hours Shift)
- Per Day Output: 4080 Pieces Approximately (Considering 3 Shift/Day)
- Approximate Salary:  $(\$127.61 \times 4) = \$ 510.44$  (Helper cost is not included Here).

**Table 2:** Laser Whisker and Scrapping SMV and Target Analysis

Name of the operation	Total Burning Time/ Pieces (Sec)	Total Burning Time (Sec)+5% Allowance	SMV	Per hour target
Laser Whisker & Scrapping	24	25	0.41	146

- Manpower Involved: 2 Operators/ 1 helper Total 3 persons Per Machine.
- Shift output :  $(270 \times 8) = 2160$  Pieces Approximately (Considering 8 Hours Shift)
- Per Day Output: 6480 Pieces Approximately (Considering 3 Shift/Day)
- Approximate Salary:  $(\$127.61 \times 2) = \$255.22$  (Helper cost is not included Here)

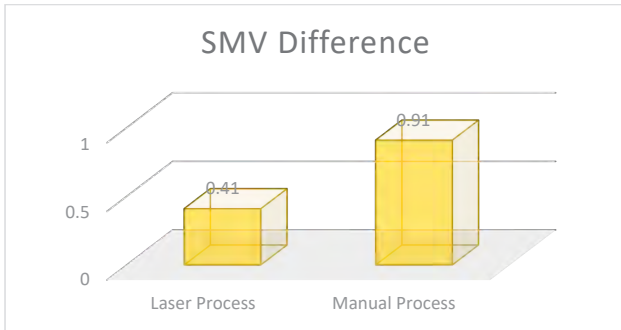


Figure 8: SMV Analysis

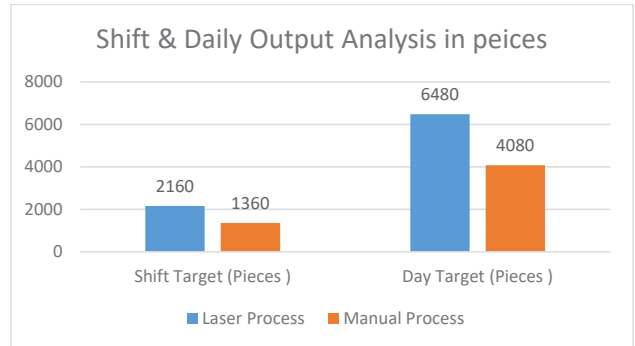


Figure 10: Shift & Daily Output Analysis in peices

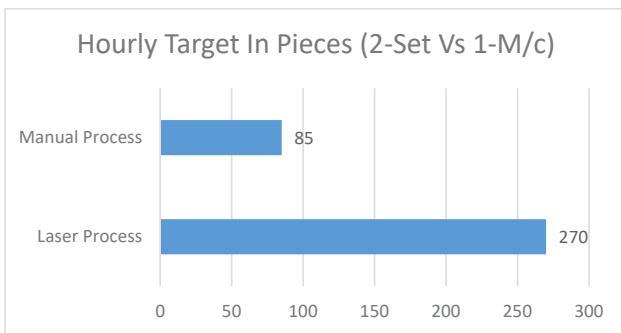


Figure 9: Hourly Output Analysis in peices

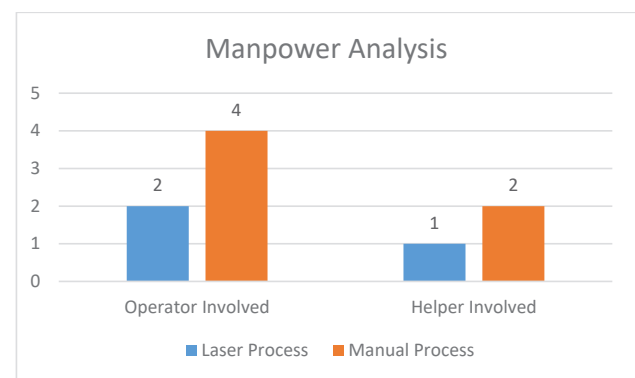


Figure 11: Manpower Analysis

### 3. WASH ANALYSIS

One side-loaded sample machine of 80 lbs. capacity was used to do the trial. The RPM was 28. The weight of 1 piece of garment was 350 grams. Two different recipes were designed for two trials. For the Manual process, a conventional recipe was used to trial 1 piece of garment. On the other hand, for the Laser process, a sustainable recipe was used to perform the task. Both outputs were the same as buyer’s required standard, but one process was sustainable and another wasn’t sustainable.

For the conventional process, P.P. Spray (Potassium permanganate- $KmnO_4$ ) was required to meet the buyer’s requirement. Where for sustainable process Laser smoothing (LSB Origin-Turkey) and Laser

enhancing (LAC Origin-Turkey) chemicals were used to eliminate the usage of P.P. Spray. For the usage of those chemicals, the laser-trialed garments didn’t require the P.P. spray process which was a hazardous chemical.[6] For sustainable trial Laser smoothing and Laser enhancing chemicals, a mixer with water was sprayed on raw garments before doing the laser.

Also on the Conventional process KCl Bleach (35% Calcium hypochlorite  $Ca(ClO)_2$ ) was applied but for the sustainable process, Eco Bleach(Origin-Turkey) was applied. Here extra cleaning processes before bleaching and neutralization processes after bleaching were required for the conventional process. Those processes were eliminated by using Eco bleach in a sustainable process. As a result, process timing, chemical, and water were saved by a margin [7-10].



Figure 12: Final output after wash for Both Trial Manual (left) Laser (Right)

**Table 3:** Conventional Wash Recipe for Manual Process Trial

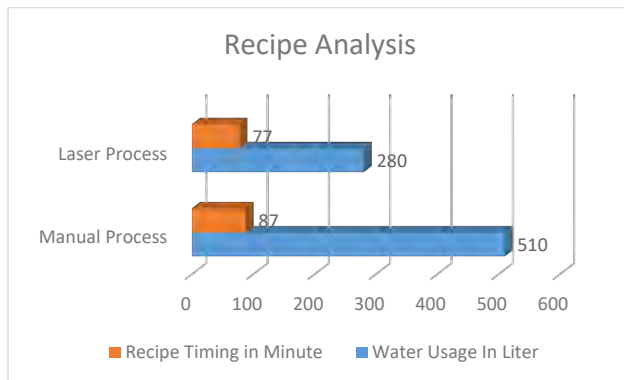
Process Name	Water(Liters)	Temperature	Chemical Name	Dosing	Time (Minute)
Desizing	50	50 Degree Celsius	Anti-Back-staining Agent	1 g/l	10
			Desizing Agent	1 g/l	
Rinse	50	RT			5
Enzyme	0	RT	Lava cell NSY (Water-Free)	2% owg	30
Clean Up	50	50 Degree Celsius	Hydrogen Peroxide	2 g/l	5
			Anti-Back-staining Agent	1 g/l	
Send For P.P. Spray					
Bleaching	70	50 Degree Celsius	35% Calcium hypochlorite	10 g/l	10
Rinse	50	45 Degree Celsius			5
Rinse	50	RT			5
Rinse	50	RT			5
Neutralization	50	RT	Sodium Meta-bisulphate	1 g/l	5
Clean Up	50	50 Degree Celsius	Hydrogen Peroxide	2 g/l	5
			Anti-Back-staining Agent	1 g/l	
Softening	40	RT	Anti-Ozone Softener	2 g/l	2
Send For Hydro Extracting and Drying					

**Table 4:** Laser smoothing and Laser Enhancing Chemical Mixture Making

Laser Boosting Mixture	
Water Taken	100 ml
Laser smoothing (LSB)	35 gram
Laser enhancing (LAC)	15 gram
Load the mixture in spray gun	
Spray on the surface of Raw Garments	

**Table 5:** Sustainable Wash Recipe for Laser Process Trial

Process Name	Water(Liters)	Temperature	Chemical Name	Dosing	Time (Minute)
Desizing	50	50 Degree Celsius	Anti-Back-staining Agent	1 g/l	10
			Desizing Agent	1 g/l	
Rinse	50	RT			5
Enzyme	0	RT	Lava cell NSY (Water-Free)	2% owg	30
Bleaching	40	50 Degree Celsius	Eco Bleach	13 g/l	20
Rinse	50	RT			5
Clean Up	50	50 Degree Celsius	Hydrogen Peroxide	2 g/l	5
			Anti-Back-staining Agent	1 g/l	
Softening	40	RT	Anti-Ozone Softener	2 g/l	2
Send For Hydro Extracting and Drying					



**Figure 13:** Recipe Timing and Water Consumption Analysis for Both Process

#### 4. RESULT AND DISCUSSION

This paper clearly showed many advantages of the Laser Whisker and Scrapping process over the Manual Whisker and Scrapping process. Daily production per shift in the case of manual process was much less than laser process. Also for manual process manpower involvement was much higher than laser process. As a result, the laser process was much more economical than the manual process. Because by implementing less manpower high amount production can be achieved.

On the other hand, for laser process a sustainable recipe was implemented by replacing P.P. spray which is a hazardous chemical. Many buyers want to remove this process from denim washing. Here Laser smoothing and Laser enhancing chemicals successfully replaced the usage of Potassium permanganate- $Kmno_4$ .

Also the water consumption was also minimized. The manual process trialed garments recipe required 510 liters of garment to wash 1 piece of garment where laser process trialed garments recipe required only 280 liters of water. Total 230 liters of water was saved also some processes were deducted due to usage of Eco Bleach instead of KCl Bleach in Laser processed garment.

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