

## Effect of Pumice Stone and its Substitutes on Denim Garments during Acid Wash

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### ABSTRACT

Garment washing is a very popular method to modify the outlook of garments and create a new, different and unique effect. Acid wash is done to create an irregular fading effect as well as an effect on physical and mechanical properties of the garments. In this study, acid wash was done with same concentration of liquor but with different associates such as pumice stone, cock sheet, thermocol ball, and a towel. This paper shows the impact of acid wash on three different composition fabrics, one of them 100% cotton, indigo dark, denim fabric, another was 98.5% cotton 1.5% spandex, indigo denim fabric and last one was 94.5% cotton 5.5% spandex, indigo denim fabric. The physical properties and rubbing fastness properties were analyzed before and after washing. The properties that were analyzed include tensile strength, tear strength, fabric weight, shrinkage percentage and color fastness to rubbing. Acid wash with different associates on different composition fabrics exhibit a great difference in the physical properties than the unwashed garments. But the samples have shown almost similar results for rubbing fastness.

Keywords: Acid wash, cock sheet, denim, pumice stone, thermocol ball, towel.

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### Introduction:

Fashion designers and textile manufacturers are developing various types of visual new appearance on sewn garments. Different types of denim washing techniques have been used to create a large variety of garments for the last few decades. (Sariisik, M. 2004, Cavaco-Paulo, A. 1998, Özdil, N. et al. 2003, Cheung, H.F. et al. 2013) Washing is measured at the concluding step in denim production and is the basis of denim finishing. (Paul, R. and Naik, S.R. 1997a, b) Nowadays besides denim washing, knit garments such as T-shirts, Polo shirts, and trousers are also washed by using different techniques such as enzymes wash,

softener wash, Silicone wash, tie dye wash, pigment wash, caustic wash, etc. and are used to create or enhance physical and mechanical property changes. (Solaiman, M et al. 2014, Islam, M 2016) After washing, garments gain a superior quality in hand feel which is not possible to achieve by other processes. (Kan C.W, 2013) Acid washing is one kind of localized washing which is done by potassium permanganate and pumice stone or other substitute. (Gokarneshan, 2009). In this study, the effect of acid wash with different associates like thermocol balls, pumice stone, towels, and cock sheet was done on three different denim construction fabrics with different composition and various properties like

fabric weight, tear strength, tensile strength, shrinkage percentage and rubbing fastness and were analyzed according to standard methods.

**Materials and Methods:**

**Garment Sample:**

Sample 1: 100% cotton, indigo dark, denim fabric.

Sample 2: 98.5% cotton 1.5% spandex, indigo denim fabric.

Sample 3: 94.5% cotton 5.5% spandex , indigo denim fabric.

Above three samples were collected from Ananto group

**Pumice stone:** Perforated stone. Size 2-3 cm, 3-5cm, 5-7 cm

**Towel:** 6x6 inch area towel was used for acid rain effect.

**Thermocol ball:** Rubber and foam. Size 32mm, 38mm, 48mm

**Cock sheet:** 3x3 inch, customize.

**Chemicals:** Phosphoric acid ( $H_3PO_4$ , Yalong, China) and potassium permanganate ( $KMnO_4$ , GC, China), Jet (an anionic detergent, Bangladesh).



**Fig. 1 Pumice stone**



**Fig. 2 Towel**



**Fig. 3 Thermocol ball**



**Fig. 4 Cock sheet**

## Methods

**Table 1. Recipe of Acid wash**

|                                                |                               |
|------------------------------------------------|-------------------------------|
| Sample:                                        | 1 piece                       |
| Water:                                         | 1 Liter                       |
| Potassium permanganet ( $KMnO_4$ ):            | 10 g/l                        |
| Phosphoric Acid ( $H_3PO_4$ ):x                | 10 g/l                        |
| Sodium meta bisulphite :                       | 3 g/l                         |
| Detergent:                                     | 1 g/l                         |
| Pumice stone/ thermocol ball/towel/cock sheet: | 0.1% on the weight of garment |
| Machine speed(Tonello) :                       | 16-17 RPM                     |
| Time:                                          | 15 minutes                    |

### **Working procedure**

At first make a solution of phosphoric acid and potassium permanganate in the machine. Pumice stone/thermocool ball/towel/cock sheet were taken into the machine and sprinkle with the solution. Then the garments were loaded into the machine and run for 15 minutes. After that garments were unloaded and subjected to a cold wash with detergent in a front loading washing machine. Then the garments were neutralized by sodium meta bisulphite.

### **Testing**

Acid washed denim samples were conditioned at 20<sup>0</sup>C temperature and 65% relative humidity according to ASTM D1776 before subjected to testing. Then

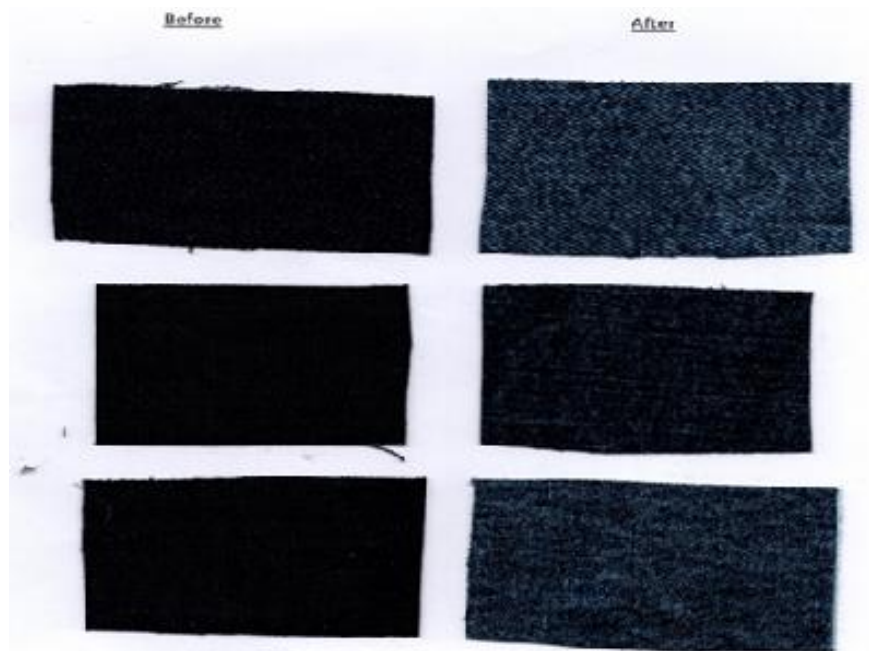
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fabric weight of before and after washed samples were measured by ASTM D3776 method. ASTM D22261 and ASTM D5034 method was followed for tear strength and tensile strength test respectively. Shrinkage percentage was determined according to ASTM D2259 method. Dry and wet rub test was done according to AATCC 8 method.

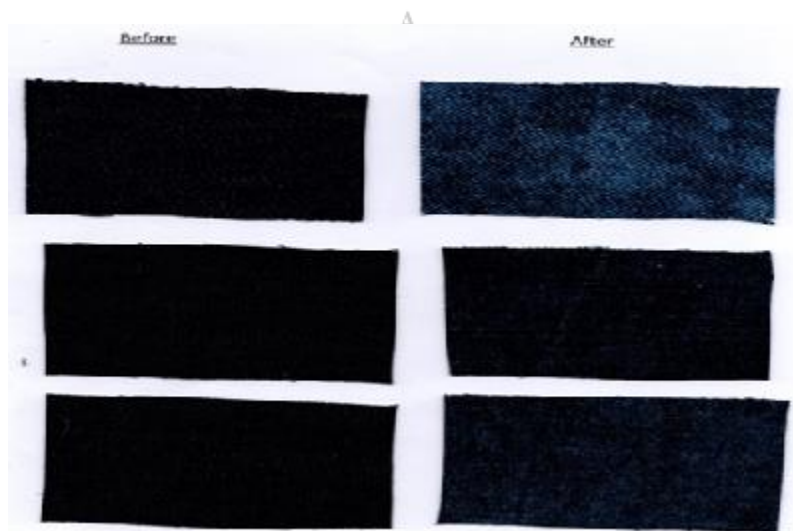
## **Results and Discussion**

### **Visual appearance**

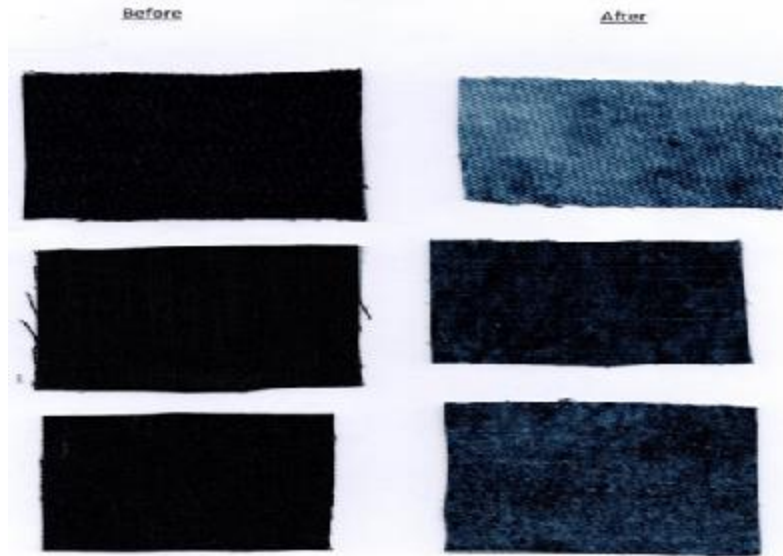
Figure 5 exhibits the before and after acid wash sample with pumice stones. From this figure it is clear that sample 1 that is 100% cotton indigo denim was faded most for the same time acid wash with pumice stone.



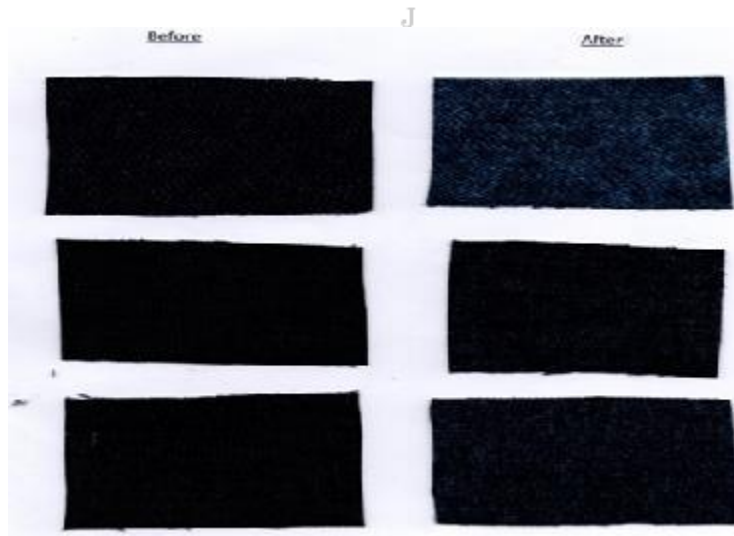
**Fig. 5 Effect of acid wash with pumice stone on sample 1,2 and 3**



**Fig. 6 Effect of acid wash with cock sheet on sample 1,2 and 3**

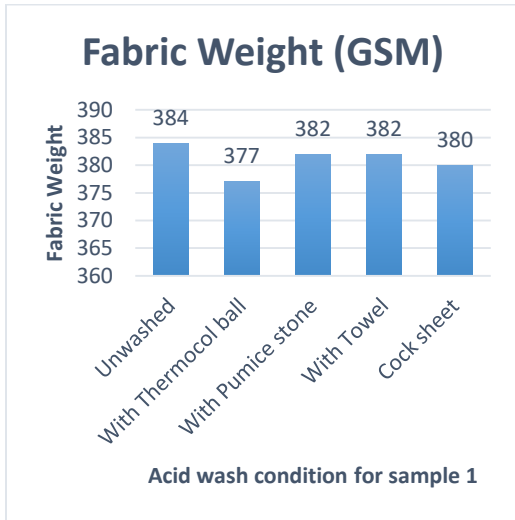


**Fig. 7** Effect of acid wash with thermocol ball on sample 1,2 and 3



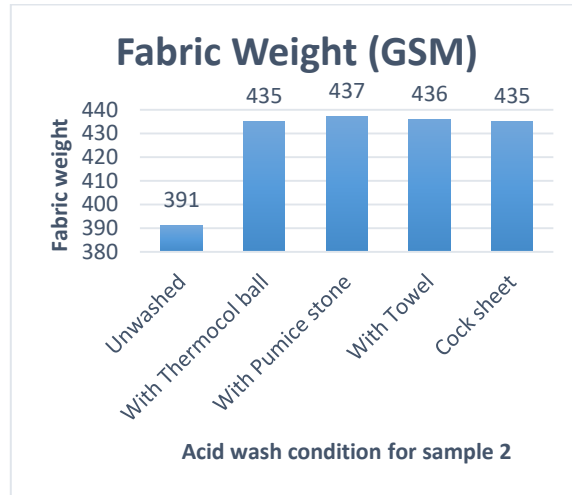
**Fig. 8** Effect of acid wash with towel on sample 1,2 and 3

**Effect of Acid Wash on Fabric Weight**



**Fig. 9 Effect of Acid wash on Fabric weight on sample 1**

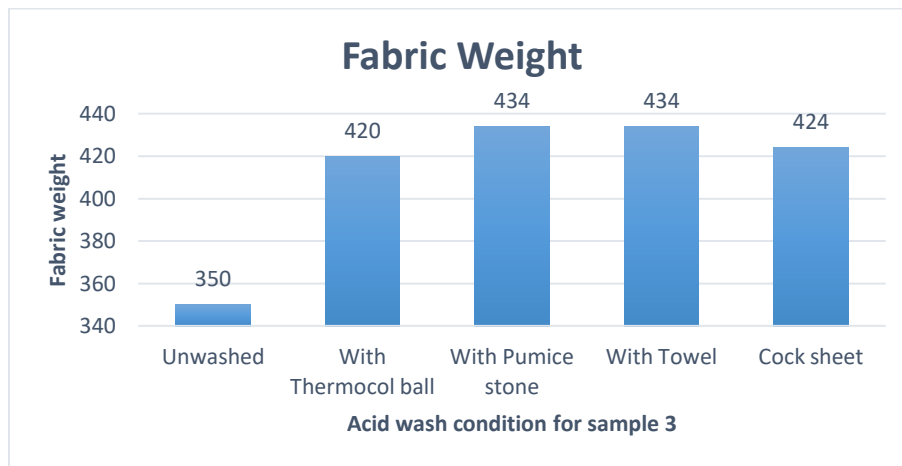
From the above figure, it has been seen that fabric weight has been decreased after acid wash with thermocol ball, pumice stone, towel and cock sheet on sample 1. But the most weight reduction was happened for the acid wash with thermocol ball and it was 377 GSM from 384 GSM.



**Fig. 10 Effect of Acid wash on Fabric weight on sample 2**

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For sample 2, it has been seen that fabric GSM has been increased after acid wash with different associate. More or less the change is same but highest was for acid wash with pumice stone.



**Fig. 11 Effect of Acid wash on Fabric weight on sample 3**

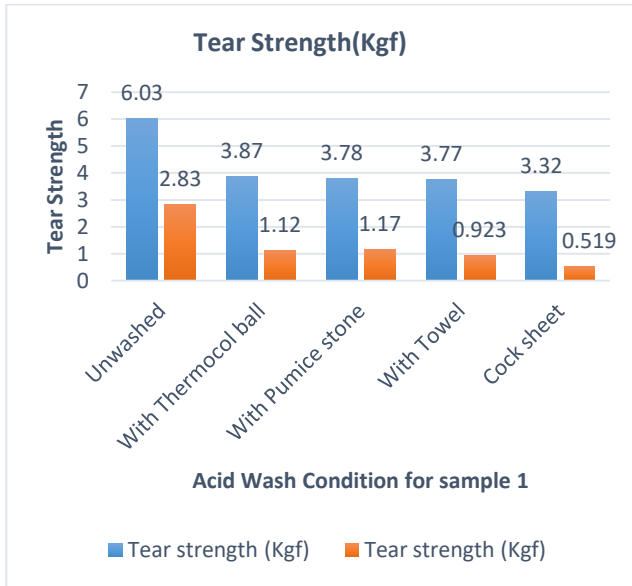
From figure 11, It is clear that fabric GSM has been increased and highest was for acid wash with pumice stone and towel.

In sample 1 as the fabric was 100% cotton so after washing, because of removing starch

and other materials, weight has been decreased.

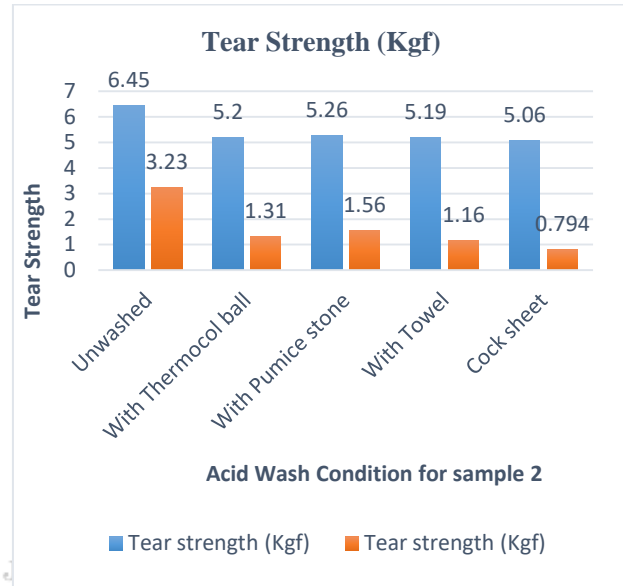
But for sample 2 and 3, as the fabric has spandex content it has been shrunk and increased the GSM after washing.

**Effect of Acid Wash on tear Strength**



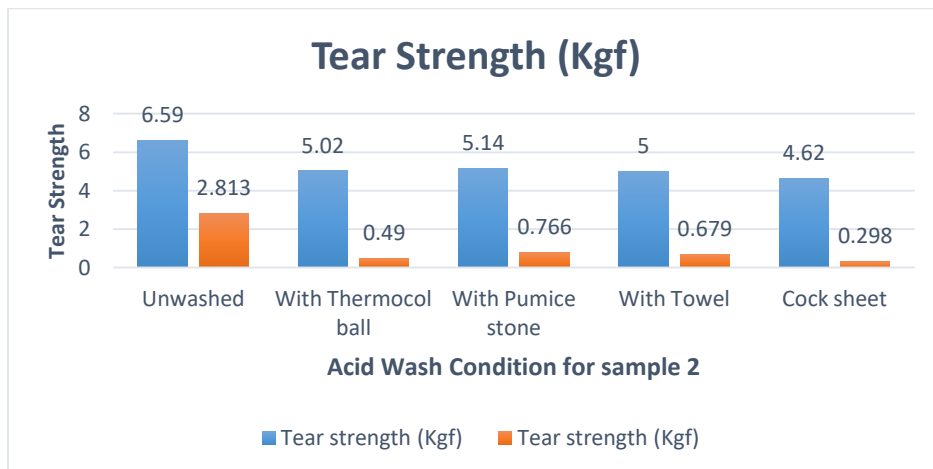
**Fig. 12 Effect of Acid wash on Tear Strength of sample 1**

Above figure shows the effect of acid wash with different associates on tear strength. It is clear from the figure both in warp and weft way tear strength has been decreased due to the action of acid and abrasion with the stones. The lowest was for cock sheet as it soaked more amount of acid and hit the garments with the acid.



**Fig. 13 Effect of Acid wash on Tear Strength of sample 2**

From above figure it has been seen that for sample 2 tear strength was also fallen due to washing and mostly was for acid wash with cock sheet.



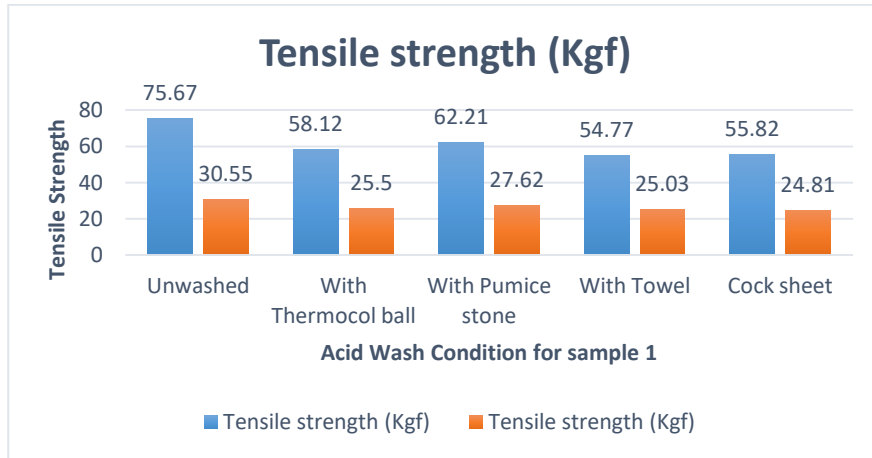
**Fig. 14 Effect of Acid wash on Tear Strength of sample 3**

Above figure shows that for sample 3 tear strength was also fallen due to washing and mostly was for acid wash with cock sheet.

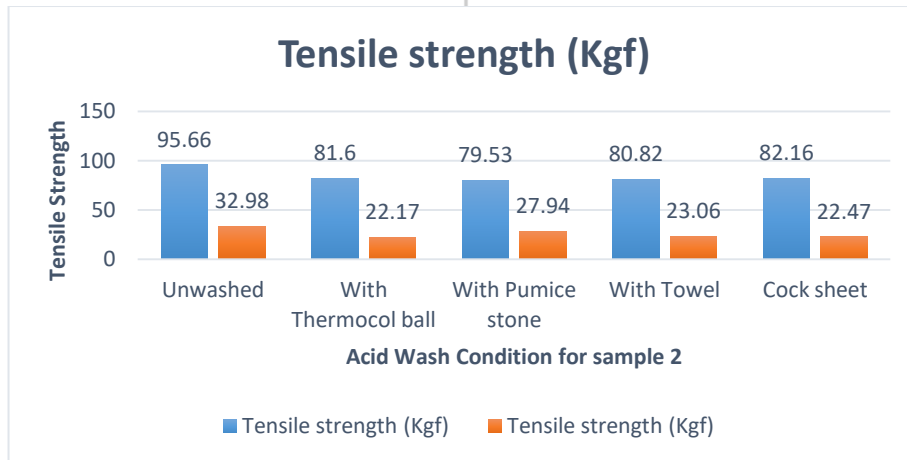
sheet on tensile strength. From above figure it has been seen that for sample 1 tensile strength was fallen due to washing and mostly was for acid wash with towel and cock sheet on warp and weft way respectively.

**Effect of Acid Wash on Tensile Strength**

Figure 15 shows the effect of acid wash with thermocol ball, pumice stone, towel, cock



**Fig. 15 Effect of Acid wash on Tensile Strength of sample 1**

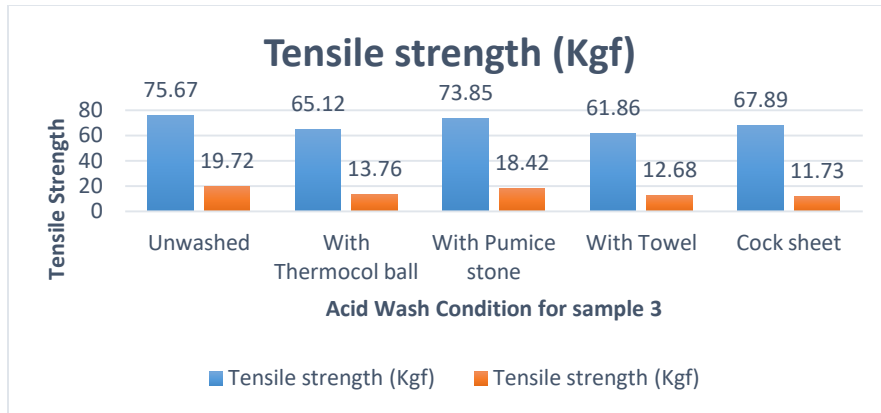


**Fig. 16 Effect of Acid wash on Tensile Strength of sample 2**

Above figure shows that for sample 2 tensile strength was also deteriorated for the action of acid and the lowest value was for wash

with pumice stone in warp way and cock sheet for weft way.



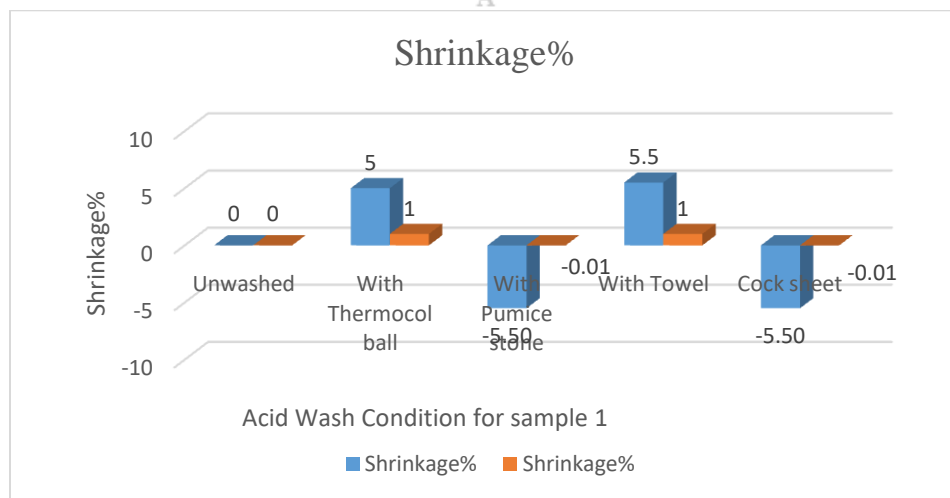


**Fig. 17 Effect of Acid wash on Tear Strength of sample 3**

Above figure shows that for sample 3 tensile strength was also decreased after acid wash and the lowest value was for wash with towel in warp way and cock sheet for weft way.

So, it is clear from the above 3 sample mostly deterioration of tensile strength was occurred for acid wash with cock sheet due to the soaking and applying of acid more.

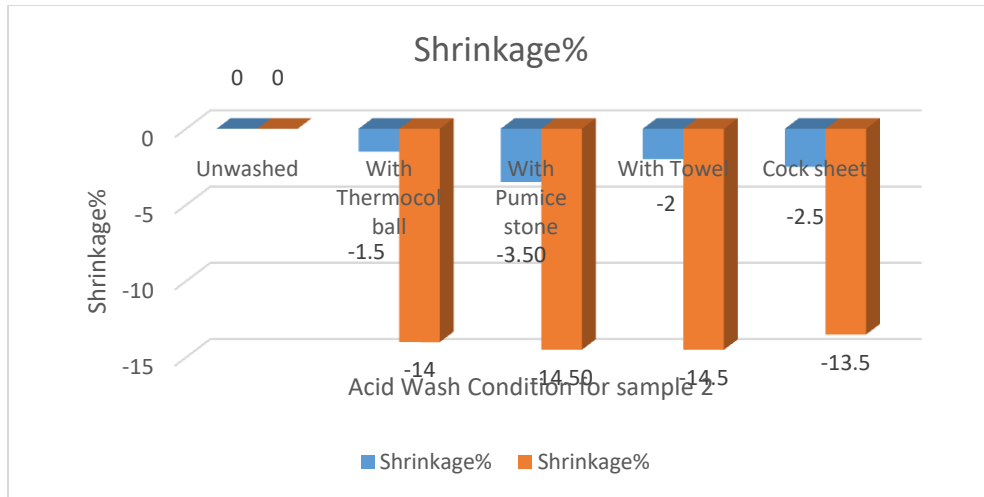
**Effect of Acid Wash on Shrinkage Percentage**



**Fig. 18 Effect of Acid wash on Shrinkage% of sample 1**

Figure 18 reflects the effect of acid wash on shrinkage percentage. Here we can see that the dimension was increased for acid wash with thermocol ball and towel but decreased

for acid wash with pumice stone and cock sheet. In both warp and weft way.

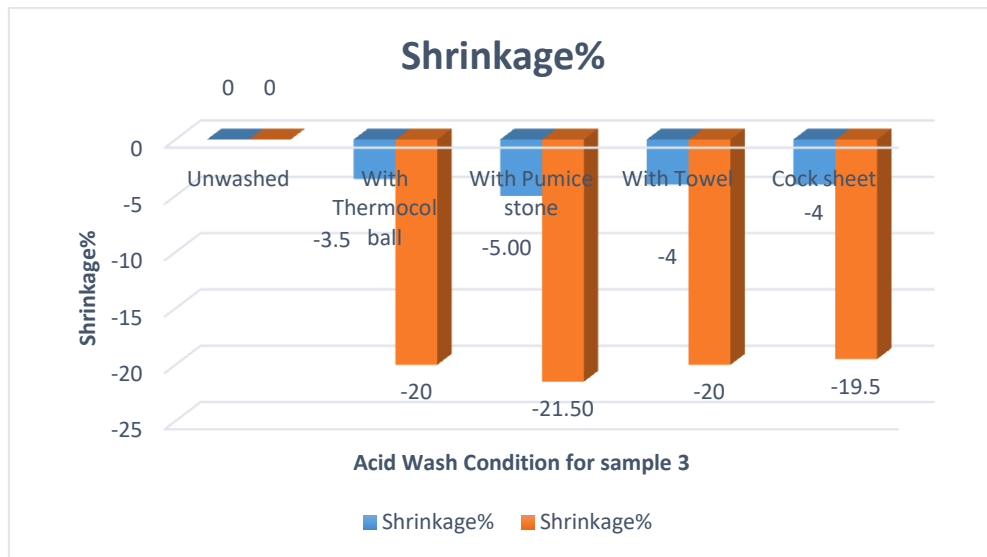


**Fig. 19 Effect of Acid wash on Shrinkage% of sample 2**

From above figure it has been seen that shrinkage% was negative for the sample 2 after acid wash and it was most for pumice stone.

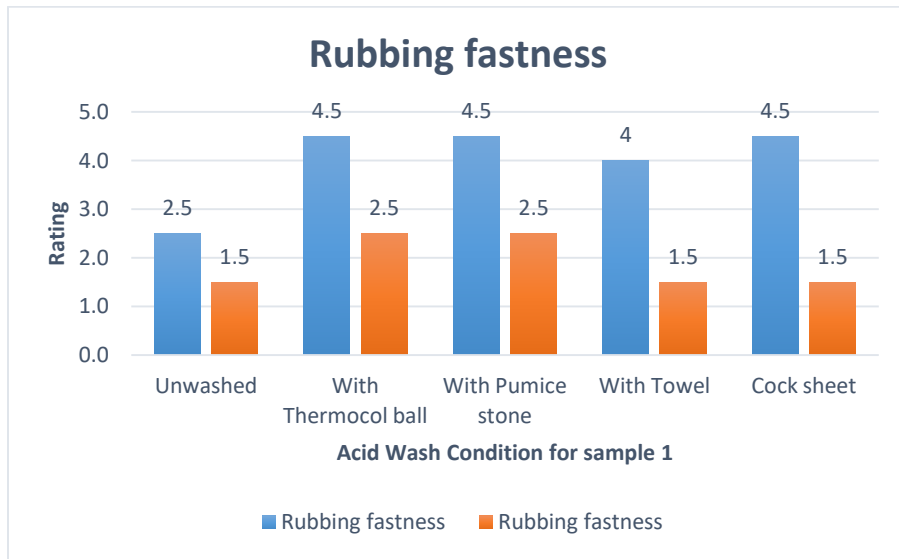
Figure 20 presents the shrinkage% of sample 3 after acid wash. The shrinkage% was highest for acid wash with pumice stone.

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**Fig. 20 Effect of Acid wash on Shrinkage% of sample 3**

**Effect of Acid Wash on Rubbing Fastness**

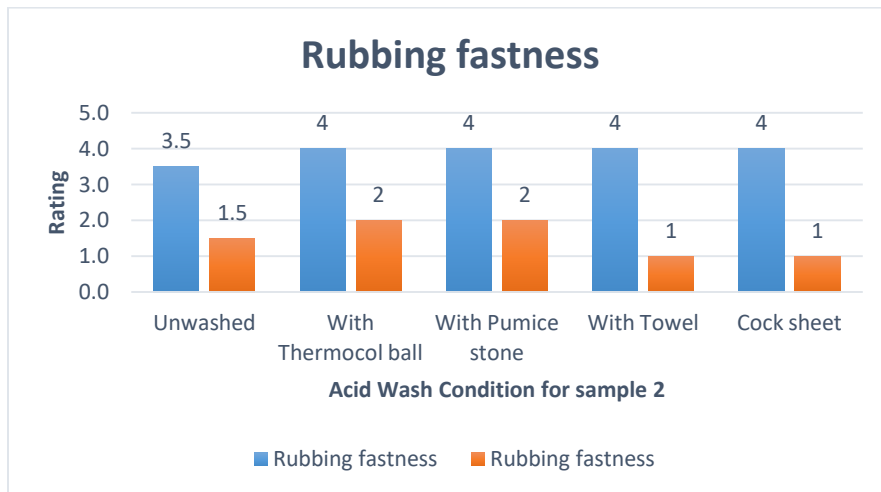


**Fig. 21 Effect of Acid wash on Rubbing Fastness of sample 1**

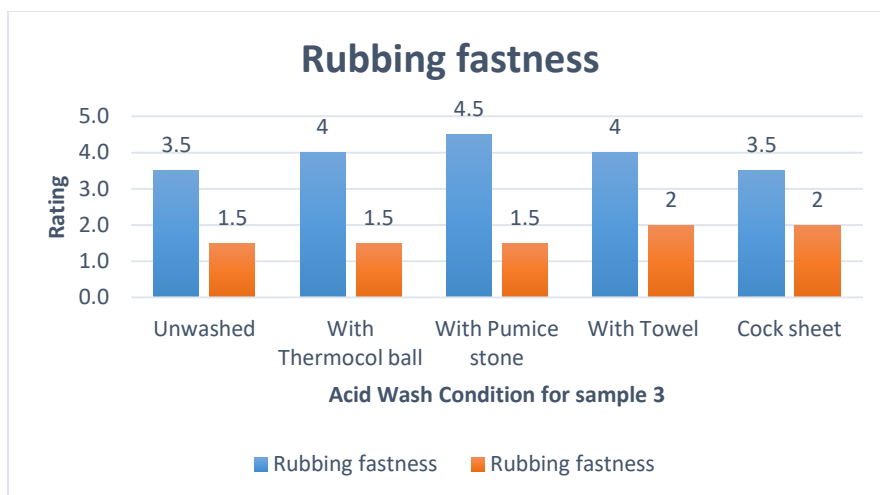
Figure 21 represents the effect of acid wash on rubbing fastness. After washing fastness was better for both dry and wet rub as the unfix dye was removed with washing.

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Figure 22 shows the effect of acid wash on rubbing fastness on sample 2. After washing, fastness was better for dry rub as the unfix dye was removed with washing. But wet rub was poorer than dry rub.



**Fig. 22 Effect of Acid wash on Rubbing Fastness of sample 2**



**Fig. 23 Effect of Acid wash on Rubbing Fastness of sample 3**

Above figure demonstrate the effect of acid wash on rubbing fastness. In a similar manner, sample 3 was also improved its fastness against dry and wet rub after washing and it was highest for wash with pumice stone.

### Conclusion

Acid wash has a great effect on denim garments. A wide range of design. In this study, three types denim fabric panel was subjected to acid wash with towel, pumice stone, thermocol ball and cock sheet. These different associate has created different look on denim. It has also effect on fabric weight, tear strength, tensile strength, Shrinkage%, rubbing fastness. After acid wash fabric GSM was decreased for 100% cotton denim but increased for the denim with spandex content and it was mostly increased for the acid wash with pumice stone. Both tensile and tear strength has been decreased for all samples after washing and the highest strength loss was for acid wash with towel in warp way and cock sheet for weft way. For the sample 1 shrinkage % was both negative and positive but for sample 2 and 3 it was negative due to stretch fabric contraction. Rubbing fastness was also improved after acid wash on all samples and highest was for acid wash with pumice stone. So, it can be said that different associate of acid wash like towel, pumice stone, cock sheet, thermocol

ball has more or less similar effect on physical properties but with different value.

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