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Effects of Dry Washing Process on Denim Garment

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Authors' contributions

This work was carried out in collaboration of all authors. All authors read and approved the final manuscript.

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ABSTRACT

Denim garment is most widely used due to its appearance, comfort, strength, durability and low cost, which gives the customers utmost satisfaction. Denim garment does not inherit customer's desired properties in the primary stage of manufacturing, but can be incorporated desirably by applying some finishing treatment, most widely known as dry washing process, in the denim garment. The most widely used dry washing processes for denim garment to develop new a look and effect are hand brush, destroy, tagging, pressing crinkle, whiskering and PP spray. We applied a combination of dry washing process on raw sample to develop certain effect in the denim and measured the change of physical properties due to application of different dry washing process. First, a combination of dry washing process (certain number) is applied on raw sample and repeated on other four similar raw samples. Similarly other five combination of dry washing process, are applied on raw samples. Due to the application of these combinations of dry washing process on raw samples, they undergo changes of some physical properties like GSM, tear strength and EPI & PPI. Then the average values of these properties (GSM, tear strength and EPI & PPI) for repeated application of combination of dry washing process on similar raw samples are

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calculated. Then the difference between the average value and the raw value of specific properties is calculated to show the deviation due to the application of combination of dry washing process. This gives an indication of change of physical properties due to application of different dry washing processes for imparting desired effect on denim garments.

Keywords: Denim garment; denim dry washing process; GSM; tear strength; EPI & PPI.

1. INTRODUCTION

Denim is a durable cotton twill-weave woven that typically used to make jeans. For many years blue denim for jeans, was made from all cotton fibres. In the last 10-15 years, there's been a trend towards blended fibres to create a more comfortable garment with greater ease of movement for the wearer. First and foremost, denim is a durable fabric made from a special twill weaving process where the dyed yarns run lengthwise of the fabric to predominate appearance called warp yarn and the white or undyed yarns run across the width direction called weft. Without washing denim garment is uncomfortable to wear, due to its weaving and dyeing effects. It essentially needs a finishing treatment to make it softer, suppler and smooth which enhance wearer's comfort. Denim washing is one of the most widely used finishing treatments that have wide range of usage due to its effects on appearance and comfort. Dry process, the most important finishing treatment for denim, is done to impart tagging, grinding, destroy, whiskering, permanent wrinkle, P.P spray, hand crapping and 3D effect on denim [1].

2. HISTROY OF DENIM

In fashion history, denim continues to puzzle. No one truly knows the perfect answer where jeans began. The phrase denim is thought to derive from several sources. No one is totally certain where the words come from. A majority of source books suggest that denim derives from the English translation of the French phrase 'serge de Nimes'. Denim fashion history is thus associated with Serge de Nimes. When talking about denim the name Levi´s is one of the first to be mentioned. Levi´s which stands for Levi Strauss is normally called the forefather of jeans. When tracing back the history of these trousers to its origins it is true that Levi Strauss played an important role concerning their development and distribution.

Levi Strauss found out that the gold diggers´ hard work in the mines made their clothes get worn out very quickly and he produced stout working trousers out of the sail cloth he had taken with him which he called "half overalls". When he continued producing these trousers he used cheap cotton fabrics coming from Genova.

At the end of the sixties of the19th century he replaced the brown sail cloth by an indigo-dyed, wear resistant cotton fabric coming from France. The name of this fabric was "Serge de Nimes". Serge is the French Expression for combined twill and Nimes is the French town where the fabric comes from. The fabric´s name Serge de Nimes was quickly turned into "Denim" in American colloquial language. By applying this indigo-dyed combined twill the first jeans out of Denim was almost born or better sewn.

About 1947 denim made a break-away from work clothing image, chiefly in the area of sportswear and rainwear and an occasional appearance in high fashion collections as a "different-looking" evening dress. In 1970 American youth adopted denim as their favorite fabric. Part of a "back to nature" movement that emphasized ecology and the natural denim being a fabric created from a natural fiber was a primary factor. Since 1960 the jeans business has undergone an explosive transformation, from a source of tough, cheap clothing for cowboys, blue-collar workers and penniless youth into a fashion conscious market for a widening mass of people of almost all ages [2].

3. LITERATURE REVIEW

The study is related to the combination of dry washing process on denim and their effect on denim. Dry washing process is the most important finishing for denim to improve the look which influences the physical properties of denim. Most important dry washing processes used for denim are destroying, hand brush, tagging, whiskering, potassium permanganate (P.P) spray, and crinkle. A number of combinations of dry washing process are carried

out on denim to get desired effect. The change of the physical properties of denim due to combination of dry washing process is measured in terms of GSM, tear strength, and no of EPI & PPI.

Now-a-day's dry washing process is most widely used to get the effect on denim by replacing the conventional process. These processes are carried out to control the physical properties of denim.

3.1 Destroying

Destroying is an art of making denim unique & used look. To make destruction pen type of stone tools being used in mid of wash process to apply on desired area. It can also be achieved by cutting it thru knife the warp yarns & keep the weft yarn as is to show white thread. Holes also can be made by cutting weft & warp yarns. These are all manual processes & every garment will look unique & different than others. Different types of machine used for destroy the garments. Such as- Grinding Machine, Emery Cloth, Hacksaw Blade, Needle, Knife etc. [3].

3.2 Tagging

Tacking or more commonly tag pinning is a very in fashion style in denim garment in these days. The procedure is very simple and proceeds as; garment is folded on required area and tacked through folds. Number of folds can be two to four or five in regular in tacking. Pin holes are some time a problem to this process. Care is to be taken to avoid this. This damage can be prevented by increasing the number of folds in one pin or by selecting the size of pin which is not loses to fold. This problem can never be eliminated but can be minimized to considerable limits. Automated tacking machines are used more successfully in some units. These machines are bit expensive but are far more efficient and secure than tag guns [4].

3.3 Whiskering

Mustaches or whiskers are one of the most important designs of a used look garment. The idea of whiskers is taken from the worn out lines and impression patterns generated by natural wearing on hips and front thigh area. On old jeans, a number of patterns can be found consequential to fabric, body shape of user or sitting posture. Various methods are designed to create this impression on jeans. Engraved patterns are used here to give whiskering effect [4].

3.4 Potassium Permanganate (P.P) Spray

Potassium permanganate spray is done on jeans to take a bright effect on sand blast area. One important thing about potassium permanganate spray is, this is usually a sporting process to increase the effect of sand blast. Potassium permanganate solution is sprayed on blasted area of jeans garment with the help of normal spray gun. This potassium permanganate spray appears pink on garment when fresh and turns to muddy brown on drying. The garment is hanged in open to dry after potassium permanganate spray and when the potassium permanganate turns its colors completely then it is considered to ready for next process.

A potassium permanganate spray concentration ranges from .25 gm per liter to 15.00 grams per liter depending to required results and fabric types. Usually indigo died fabrics are treated with low concentrations whereas black sulfur fabric requires high concentrations to treat with. Sulfur is not much affected with potassium permanganate and hence requires high concentrations and even sometime multiple spray operations. It is more effective to add potassium permanganate brushing to aid the spray effect [4].

4. CHEMICAL, MATERIALS, METHODS AND INSTRUMENT

4.1 Method for Hand Brush

First of all the garment is mounted on rubber balloon. After mounting the garment air balloon is filled with air to expose the area to operate. Then emery paper (320) is being used to scrape the garments in particular placement & design of garments to get the distressed look. Then the garment is sent for further processing. Finally the garment is washed to get the desired effect [5].

4.1.1 Materials used

Emery Cloth.

4.2 Method for Destroy

Destroy effect is achieved manually by using knife. Destroy is done by cutting the warp yarns through knife & keep the weft yarn as is to show white thread. First of all the knife is run along the

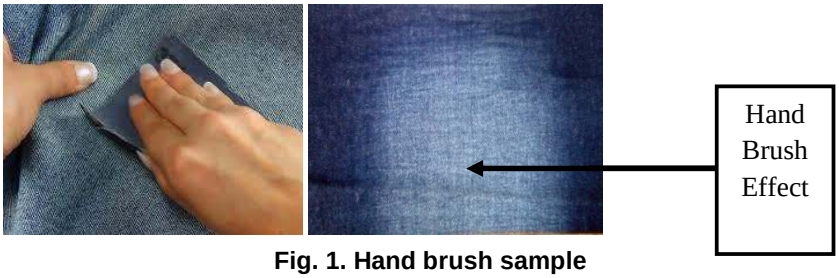


Fig. 1. Hand brush sample

Fig. 2. Destroying sample

direction of weft yarn about 10 times to cut the warp yarn up to a certain area. The area around the destroyed area is worn out to blend the destroyed area with the surrounding fabric. Finally the garment is washed to get the desired effect [5].

4.2.1 Materials used

Knife, Grinding Machine.

4.3 Method of Tagging

Tagging effect is created by swift tag machines with the help of plastic or nylon tag pins in rigid form of garment to get contrast. First, garment is folded on required area and tacked through folds by using tag pin machines. Then washing is done on the upper side of garments which results crease mark and dark shade inside of tagging. After tagging, tag pin is removed from garment making softening [5].

Fig. 3. Tagging sample

4.3.1 Materials used

Swift Tag Machines, Tag Pin.

4.4 Method for Whiskering

First, engraved patterns are made for making whisker effect. Before that the pattern is drawn on rubber sheet and engraved them with blade. Then garment is places on sheet and scrapped on specific area to draw this effect on garment. Then washing is done on the garments to get desired effect [5].

Fig. 4. Whiskering pattern

Fig. 5. Whiskering sample

4.4.1 Materials used

Engraved Pattern, Sand Paper.

4.5 Method for Potassium Permanganate (P.P) Spray

First, the garment is mounted on balloon and filled with air to get effect of PP spray. Garment is scrubbed over pattern carefully. Then potassium permanganate solution is sprayed on the blasted area of jeans garment with the help of a normal spray gun. This potassium permanganate spray appears pink on the garment when fresh and turns to muddy brown on drying. The garment is hanged in open to dry after potassium permanganate spray and when the potassium permanganate turns its colors completely then it is considered to ready for the next process. After carrying enzyme or bleach cycle more natural & white effect is achieved. Then neutralization process is carried out with sodium meta-bi-sulphate [5].

Fig. 6. Raw sample

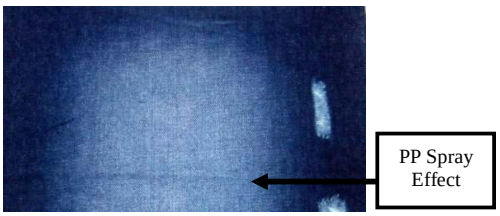


Fig. 7. PP sample

4.5.1 Materials used

Potassium Permanganate, sodium meta-bi-sulphate, Spray Gun.

4.6 Method for Crinkle/3D

First, resin (formaldehyde free) is sprayed on the specific area of garment to create 3D effect. After applying resin solution in right proportion manual designing is made on the thigh, hip & back knee area to get three dimensional effects as needed. Then it should be manually dried with hair dryer at temperature 190℃. Then curing is done properly in oven at right temperature and time as mentioned in resin product manual to get permanent effect by avoiding skin irritation to the wearer [5].

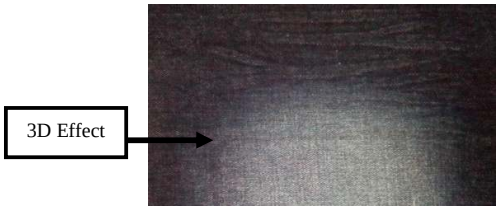


Fig. 8. 3D sample

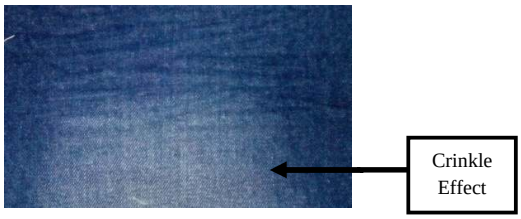


Fig. 9. Crinkle sample

4.6.1 Materials used

Resin, Catalyst, Silicone, PU solution, Dryer.

4.7 Testing Instrument

Name of instrument	Name of test
Tear strength tester	Tear strength measurement
GSM cutter	GSM measurement
Counting glass & Magnifying glass	EPI & PPI Measurement

5. RESULTS AND DISCUSSION

Here we found some changes in dry washing process. Raw sample and washed sample has got different result. Every dry process is not impacting equally on the denim. Changes are varying relating to the dry process done.

5.1 GSM Test Result

When no dry washing process is carried out, then sample-1, sample-2, sample-3, sample-4, sample-5 and sample-6 are termed as raw sample. GSM of these raw samples are known as raw GSM. Here carrying out different types of dry washing technique together we found decrease in GSM than raw GSM. Here, combination of whiskering + destroy + hand brush + pp spray has got highest decrease in gsm rather than any other process whereas combination of hand brush + pressing crinkle has

got the less decrease. Whiskering + destroy + hand brush + pp spray have got more removal of colors with yarn and fibre, that's why gsm decrease more. On the other hand, hand brush + pressing crinkle have got the less removal of colors and fibres so less decrease of gsm. Here we experienced more decrease of gsm due to destroy + hand brush as warp yarn totally damaged through destroying process. These two process impacts more on the fabric gsm.

Table 1. Combination of dry process

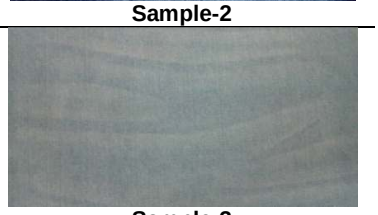
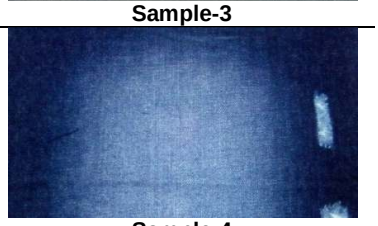
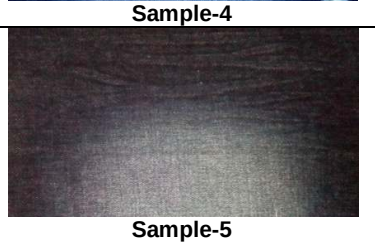
Raw sample	Combination of dry process	Dry processed sample
	**Hand brush + Destroy + Tagging (Combination 1)**	 **Sample-1**
	Hand brush + Pressing crinkle (Combination 2)	 **Sample-2**
	Whiskering + PP spray + Hand brush (Combination 3)	 **Sample-3**
	Hand brush + Destroy + PP spray (Combination 4)	 **Sample-4**
	Hand brush + PP spray + 3D (Combination 5)	 **Sample-5**
	Whiskering + Destroy + Hand brush + PP spray (Combination 6)	 **Sample-6**

Table 2. Effects on GSM

GSM of the sample / Name of the combination of dry washing process	Sample-1	Sample-2	Sample-3	Sample-4	Sample-5	Averg. GSM	Deviation from the raw GSM
No dry washing process (RAW Sample)	440	440	440	440	440	440	----------
(1) Hand Brush + Destroying + Tagging	431	428	428	427	431	**429**	**-11**
(2) Hand Brush + Pressing Crinkle	436	436	436	434	433	**435**	**-5**
(3) Whiskering + PP spray + Hand brush	432	430	431	430	432	**431**	**-9**
(4) Hand Brush + Destroy + PP Spray	428	427	426	429	430	**428**	**-12**
(5) Hand Brush + PP spray + 3D	433	433	433	433	433	**433**	**-7**
(6) Whiskering + Destroy + Hand brush + PP spray	426	427	425	424	423	**425**	**-15**

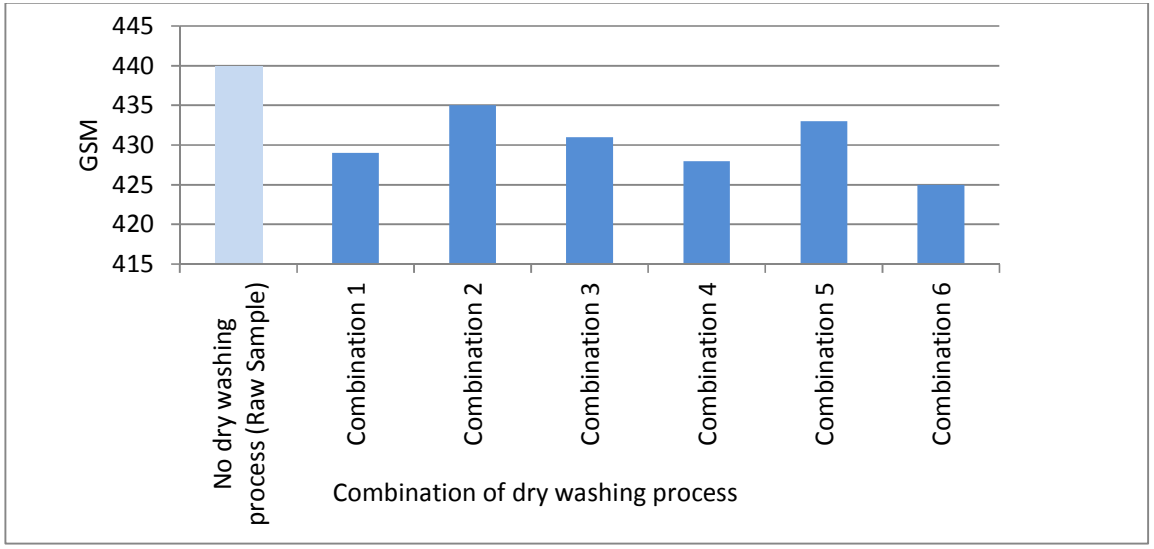


Fig. 10. Column charts of GSM measurement

5.2 Graphical Comparison of GSM

If we represent it graphically then we will find the changes combination 6 got the highest decrease in gsm and 3 got the lowest decrease in gsm.

5.3 Tear Strength Test Result

Result shows that tear strength decreases after applying dry washing techniques on denim garment. As all dry washing process is done upon the warp yarn so strength falls more in warp wise than weft wise. For combination of Whiskering, Destroy, Hand Brush & PP Spray, there is more decrease in strength for both warp and weft yarn. Here destroy process has got more impact on warp yarn so the strength of warp yarn will be more decrease. We concluded the strength of combined drying process. As drying process is done on warp wise yarn so fall of strength will be remarkably change in warp wise. If we compare the decrease of strength between warp and weft we can find it is for sure the strength of warp decreases more than the weft.

5.4 Graphical Comparison of Strength

Here more decrease in strength for combination 6 dry processes and less decrease is on combination 5.

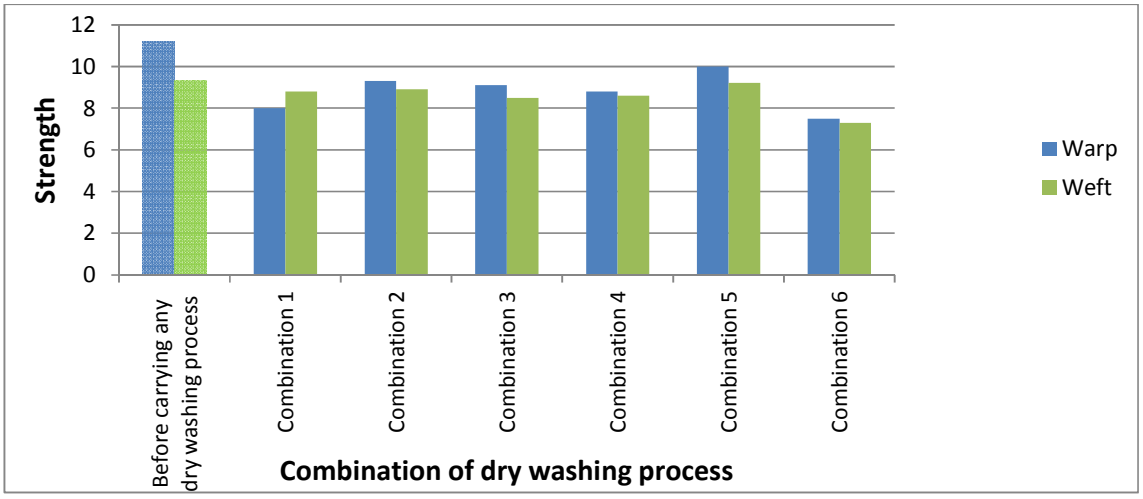


Fig. 11. Column charts of warp & weft way tear strength measurement

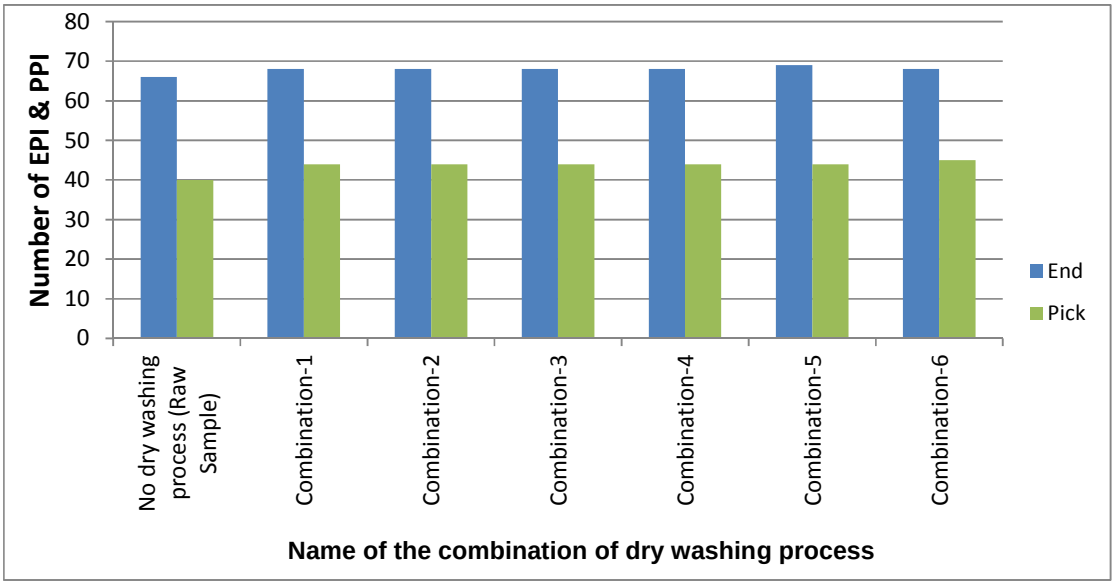


Fig. 12. Column charts of warp & weft way EPI & PPI measurement

Table 3. Effect on strength

Tear strength of the sample (lbf) / Name of the combination of dry washing process		Sample-1	Sample-2	Sample-3	Sample-4	Sample-5	Averg. tear strength	Deviation from raw tear strength
No dry washing process (Raw Sample)	Warp	11.2	11.2	11.2	11.2	11.2	11.2	-------
	Weft	9.3	9.3	9.3	9.3	9.3	9.3	-------
(1) Hand Brush + Destroying + Tagging	Warp	8.0	7.8	8.4	8.0	7.8	**8.0**	**-3.2**
	Weft	8.9	8.7	8.8	8.9	8.7	**8.8**	**-0.5**
(2) Hand Brush + Pressing crinkle	Warp	9.5	9.0	9.2	9.3	9.6	**9.3**	**-0.9**
	Weft	9.0	8.8	9.0	8.9	8.9	**8.9**	**-0.4**
(3) Whiskering + PP Spray + Hand brush	Warp	9.2	9.1	9.1	9.2	9.1	**9.1**	**-2.1**
	Weft	8.5	8.5	8.6	8.5	8.6	**8.5**	**-0.8**
(4) Hand Brush + Destroy + PP spray	Warp	8.8	8.8	8.7	8.9	8..7	**8.8**	**-2.4**
	Weft	8.6	8.6	8.6	8.5	8.6	**8.6**	**-0.7**
(5) Hand Brush + PP spray + 3D	Warp	10.0	10.1	9.9	10.0	10.1	**10.0**	**-1.2**
	Weft	9.1	9.2	9.0	9.2	9.2	**9.2**	**-0.1**
(6) Whiskering + Destroy + Hand brush + PP spray	Warp	7.5	7.4	7.5	7.5	7.5	**7.5**	**-3.7**
	Weft	7.3	7.4	7.3	7.3	7.4	**7.3**	**-2.0**

Table 4. Effect on PPI & EPI

EPI & PPI of the sample / Name of the combination of dry washing process		Sample-1	Sample-2	Sample-3	Sample-4	Sample-5	Averg. EPI & PPI	Deviation from raw EPI & PPI
No dry washing process (Raw Sample)	EPI	66	66	66	66	66	66	---------
	PPI	40	40	40	40	40	40	---------
(1) Hand Brush + Destroying + Tagging	EPI	68	68	68	67	68	**68**	+2
	PPI	44	44	43	44	44	**44**	+4
(2) Hand Brush + Pressing crinkle	**EPI**	68	68	68	68	68	**68**	+2
	PPI	44	44	44	44	44	**44**	+4
(3) Whiskering + PP spray + Hand brush	EPI	68	68	67	68	68	**68**	+2
	PPI	44	44	43	44	44	**44**	+4
(4) Hand Brush + Destroy + PP spray	**EPI**	68	68	68	68	68	**68**	+2
	PPI	44	44	44	44	44	**44**	+4
(5) Hand Brush + PP Spray + 3D	EPI	70	69	69	69	69	**69**	+3
	PPI	44	44	43	44	44	**44**	+4
(6) Whiskering + Destroy + Hand brush + PP spray	**EPI**	68	67	68	68	68	**68**	+2
	PPI	45	45	45	45	45	**45**	+5

5.5 EPI and PPI Test Result

The number of EPI & PPI increased for each combination of dry washing process.

5.6 Graphical Comparison of EPI and PPI

PPI increase at combination 6 and EPI increases more in combination 2 & 3.

6. CONCLUSION

The effects of dry washing process on denim under investigation could be realized by the comparison of GSM, tear strength, EPI & PPI. Tear strength, GSM, EPI & PPI are increased due to required wash treatment. By controlling the value of different properties like GSM or tear strength or EPI & PPI previously specific effect can be found precisely by applying a certain combination of dry washing process.

It is further noted that pre-washed denim are almost stiff and harder than the required washed denim. So in order to meet the quick change of customer demand for fashion apparel, dry washing process can be an effective way [6,7].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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