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Assessment of comfort property of jute-cotton blend denim trousers after repetitive laundering

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Abstract

In this analysis jute cotton blend denims performance at enzyme wash to 35 times respective laundering, in friction and roughness properties where 5 times laundered sample showed smoother surface in both inner and outer surface. In bending properties, 5 times laundered sample was found second lowest Bending Average Rigidity (BAR) and Bending Work (BW). In compression, highest Compression Average Rigidity (CAR), Recovery Average Rigidity(RAR) and less energy requirement Compression work (CW) to compress in both inner and outer surface was found in 5 times laundered sample. In Sensorial Comfort Aspect (SCA), 5 times laundered sample was found smoother surface property, quite higher bending property and higher compression average rigidity. Therefore, 5 times laundered sample was good sensorial comfort among all the samples. In Maximum Thermal Flux (MTF), 20 times laundered sample gives most warm feeling at inner surface because it provides minimum heat flux which ensure warmness in skin-garment micro environment. For thermo physiological comfort aspect, only 20 times repetitive laundered sample found maximum thermo physiological comfort among all samples. Thus, Jute-Cotton blend denims performance at enzyme wash to 35 times repetitive laundering up to 20 times repetitive laundering sample reported good results and the protruding fibre of jute was visible excessively on the surface.

Keywords: Comfort; Jute-cotton; Blend denim; Repetitive; Laundering.

1. Introduction

Thermo-physiological comfort of clothing is much more complex to asses when purchasing the clothing. It is dependent on the interactions between the human body, the clothing and the environment. There is another comfort that comfort known as sensorial comfort which is the Feeling of skin/body about clothing worn Prickling, itching. Stiffness, softness etc. are related with thermo-physical comfort, due to cling discomfort may arise if sweating occurs (1). Fabric properties like protruding fibres and yarn diameter, fabric thickness etc. affects the sensorial comfort. Jute is the most versatile natural fibre gifted by nature. It is the second largest fibre produced after cotton. It is relatively cheap and available natural fibre. Blending is the technique to overcome poor characteristics of that fiber (2). Jute denim is one of the prestigious uses of blended jute with cotton. It is as well as bio-degradable and economic fibre. Denim is the most spreader style accepted by all citizen of world because of it high durability and longevity (3).Jute denim has various constructions some may be plain structure, horizontal. In this research basically focused on the change of physical property like stiffness, comfort, change of Ends Per Inch (EPI), Picks Per Inch (PPI), Gram per Square Meter (GSM) and air-permeability. Due to repetitive set of laundering for this test focused on 20 cycles of wash and after each 5 cycle have tested their properties (4). The physiological comfort determined by air permeability properties of fabrics is influenced

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by various constructional parameters of the fabric which give woven fabric a porous structure. Total porosity of a woven fabric comprises two types of porosity, viz. micro porosity caused by void spaces among the fibres in the yarns and the macro porosity, which is a consequence of void spaces amongst the yarns. Interaction of liquids with textile materials involve several physical phenomenon such as wetting of fibre surface, transport of liquid into assembly of fibres, adsorption on the surface or diffusion of liquid into the interiors of fibres (5). Evaporation of sweat during wear has the potential to cool the body besides restricting the additional weight of sweat being absorbed by the fabric. Various researchers have studied the effect of different structural parameters on the thermo physiological comfort of the woven fabric .There have been several study on jute denim and its interior property improvement antimicrobial property (6) . However, no study has been found on the comfort characteristics of jute denim fabrics for respective laundering. Further, the physiological comfort is also expected to change during the repeated laundering and use of the denim (7).In present study, the effect of enzyme washing and repeated laundering on these properties has also been discussed for better insight into the comfort characteristics of these fabrics.

2. Material and methods

Jute cotton blend Denim Fabric: In order to conduct the experiments, the prime selected material was 30:70. Jute Cotton blended Raw denim fabric whose specification was- Yarn blend ratio =30:70, Weave type=2/1 Twill, GSM=340 and Fabric construction:

$$= \frac{58 \times 38 \times 56}{7 \times 16}$$

Sample Development by desized and enzyme washed: Desizing was maintained at 60 °C for 20min. The desized denim fabrics were then hot washed (70 °C) and cold washed using water. Enzyme washing was carried out at 40-70 °C temperature for 20-60 minutes. After that, softening of enzyme-washed denim was carried out for 15 min. Finally the liquor was drained out and hot wash was carried out at 40 °C for 5 min (**Fig. 1**).

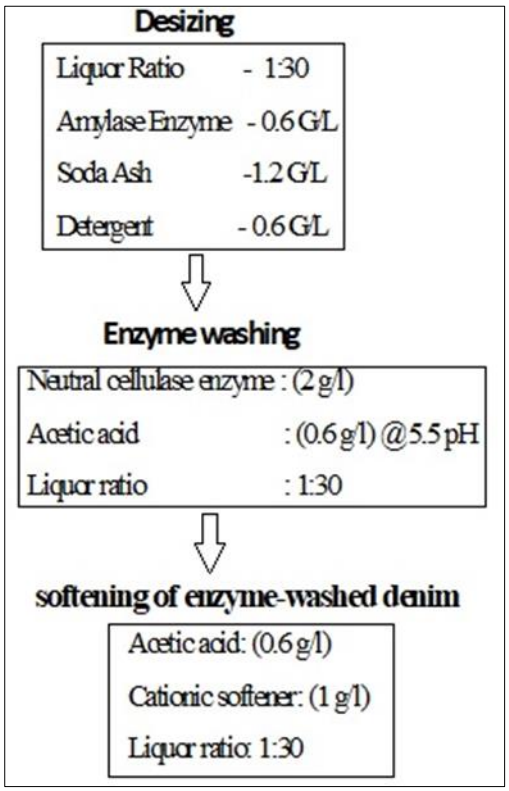

Figure 1 Desizing and enzyme washed sample

Repetitive times of laundered sample For five times, the sample was loaded by adding detergent which was then set at the mode of quick 30,30 min machine running time, 1hquick 30drying time and dry cycle. For 10, 20 and 35 times

repetitive laundered sample, same procedure was carried out as of pervious five times sample. Air permeability which affects the comfort sensation of garments was assessed with standard method.

3. Results and discussion

The changes of repetitive laundered samples were shown in Fig 2. Different laundering cycles were simulated on the jute cotton blend denim fabric specimens and their changes of air permeability were observed in Fig 3.

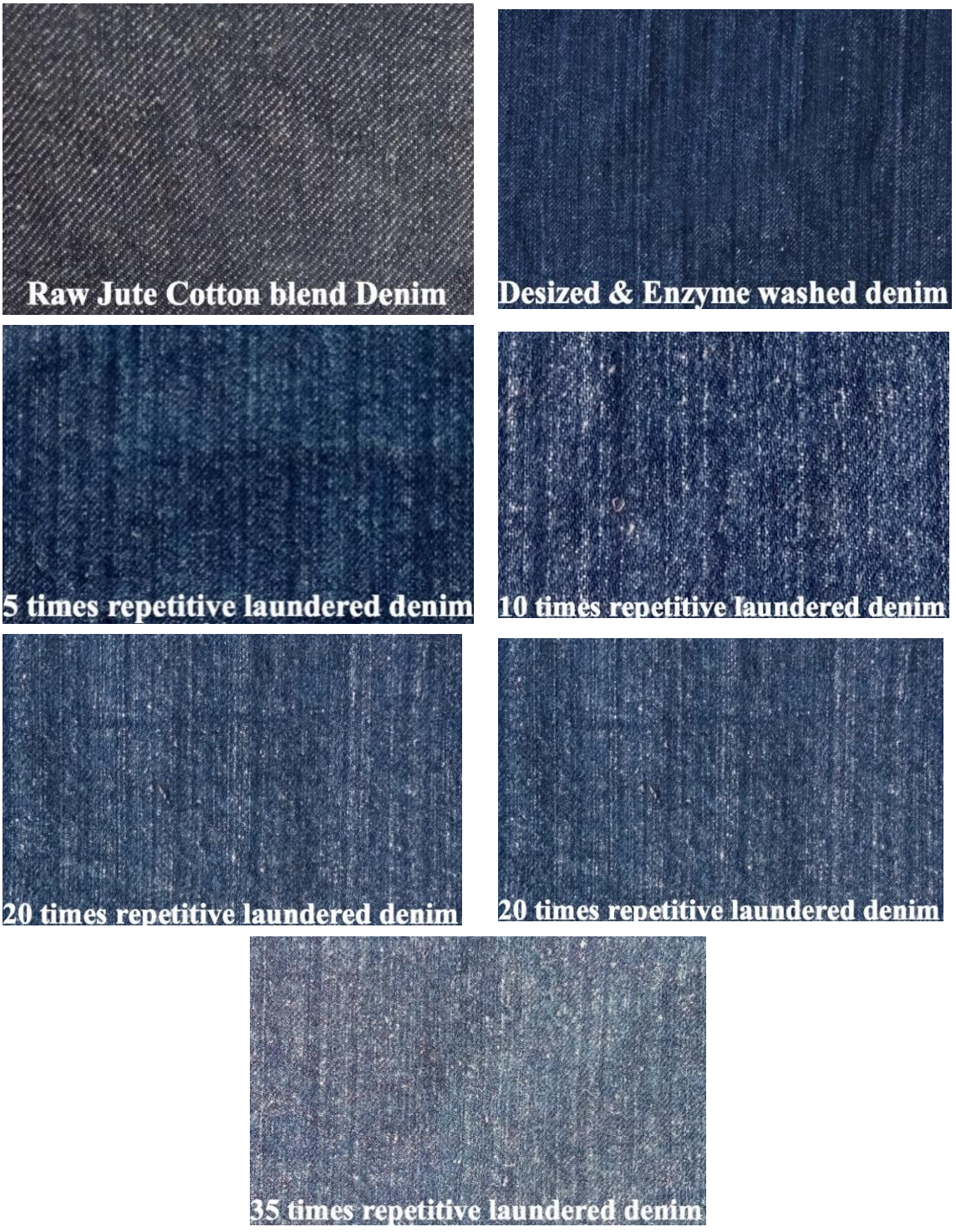

Figure 2 Repetitive laundered sample

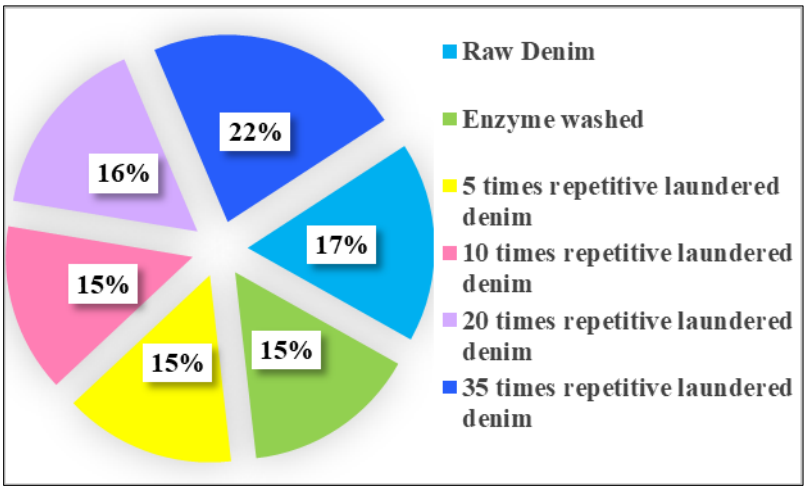

Figure 3 Air permeability percentage in different sample

In Fig 4, it was found that because of the removal of sizing material and the removal of protruding fibre, influence of fabric softner is also resposible for the low bending rigidity of enzyme washed denim, Bending Average Rigidity (BAR) of raw denim in both warp and weft way direction was decreases along with Bending Work (BW) after desizing and enzyme wash. After 5 times repetitive laundering BAR and BW was increased in both way because of the effect of fabric softner and regulade use of the trouser. But the BAR and BW in warp way direction was grater than the weft way direction. 10 times repetitive laundered denim which showed the maximum rigidity and BW in both directions among all the denim samples; that was similar to the result of air permeability and thickness along with EPI and PPI. But after 20 times repetitive laundering, BAR and BW was decreasing gradually and in 35 times repetitive laundered denim sample BAR weft way direction and BW was less than the raw sample on the other hand BAR warp way direction and BW was less than the 20 times repetitive laundered denim but not less than the raw sample (Fig 4).

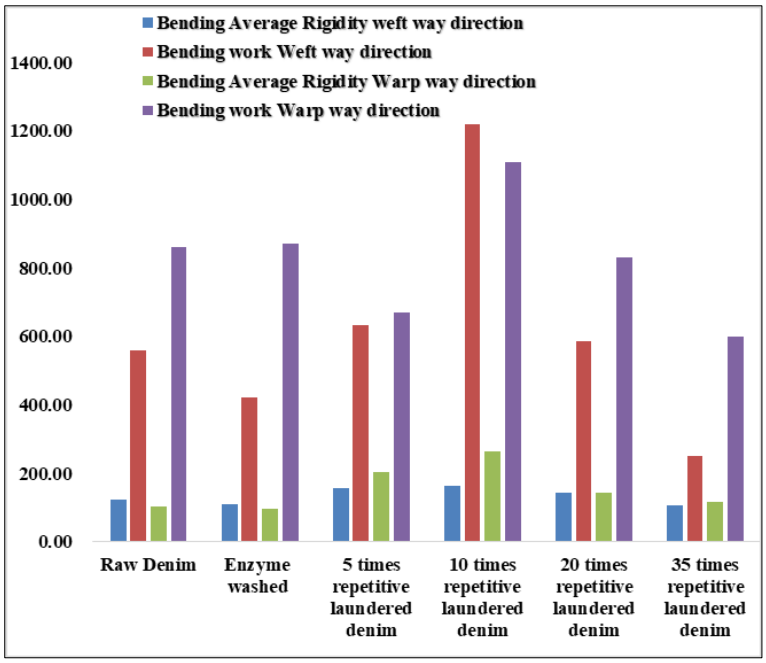

Figure 4 Bending property VS repetitive laundered sample

The in outer surface 10 times repetitive laundered denim showed Minimum Thermal Conductivity (MTC) and Minimum Thermal Flux (MTF), which means that this sample will not flow the environment heat to the body due to the least thermal conductivity and heat flux during wearing and 35 times repetitive laundered denim shows the maximum thermal flux which represents the maximum coolness during wearing (Fig 5). In inner surface 20 times repetitive laundered sample showed minimum heat flux and conductivity, which means that this sample does not flow much heat

from human body to the environment, it gives warmness and similarly like outer surface; whereas, 35 times repetitive laundered denim shows the maximum thermal flux which represents the maximum coolness during wearing (Fig 6).

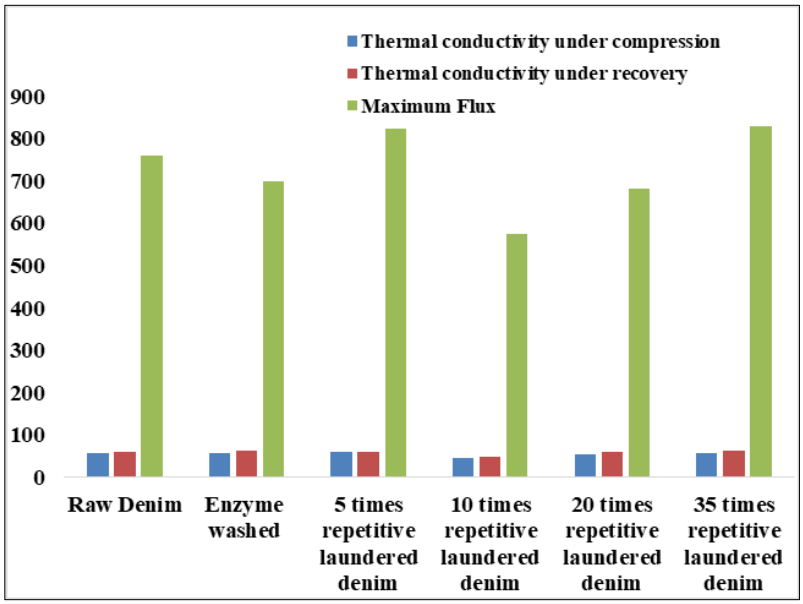

Figure 5 Flax or thermal property of outer surface VS repetitive laundered sample

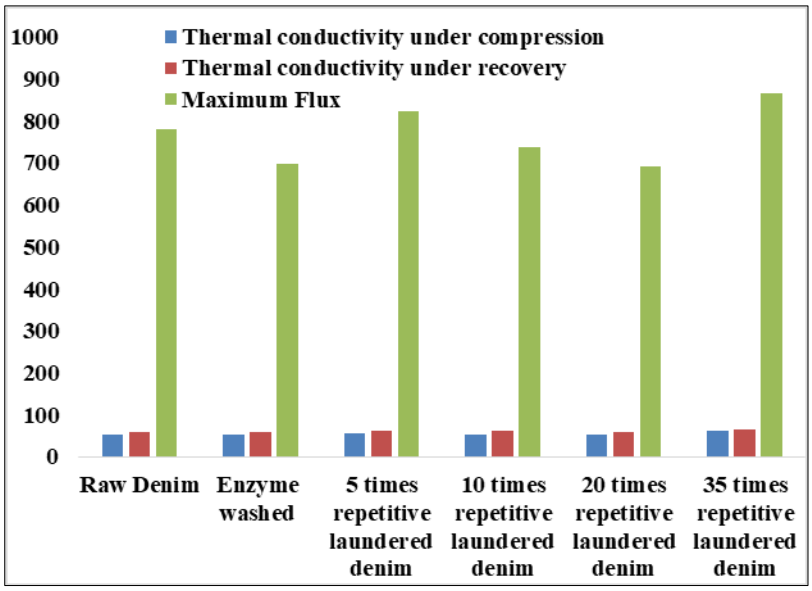

Figure 6 Flax or thermal property of inner surface VS repetitive laundered sample

Compression properties are commonly used to describe the fullness of fabric. From Fig 7 and Fig 8, 10 times repetitive laundered denim showed the most less CAR and RAR in outer surface and 20 times repetitive laundered denim showed the most less Compression Average Rigidity (CAR) and Recovery Average Rigidity (RAR) in inner surface. Less CAR and RAR resulted less Compression Recovery Rate (CRR) and highest Compression work (CW), which indicated the most energy requirement to compress the most compact sample and get to cover from the compression, From EPI and PPI results, it shows that in 10 times repetitive laundered denim sample, EPI and PPI was 80 and 68, this EPI was most among all the sample which resulted the less compression property in outer surface (Warp Face Fabric, 2/1 Twill) and in 20 times repetitive laundered denim sample, EPI and PPI was 78 and 70, this PPI was most among all the sample which resulted the less compression property in inner surface of the sample. For the rest of the sample its seen that, after reaching the most less point the CAR and RAR were gradually increase, due to the damage of the mechanical

agitation of the wearing and washing machine, looseness of the warp and weft yarn of the fabric, less EPI and PPI, more protruding fibre on the surface makes the fabric fluffy, which requires less energy to compress the fabric.

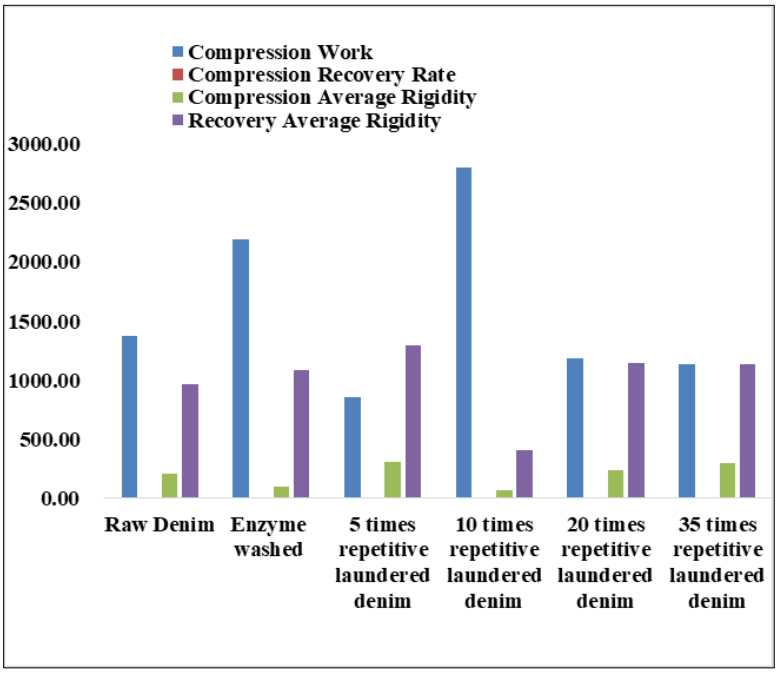

Figure 7 Compression property of outer surface VS repetitive laundered sample

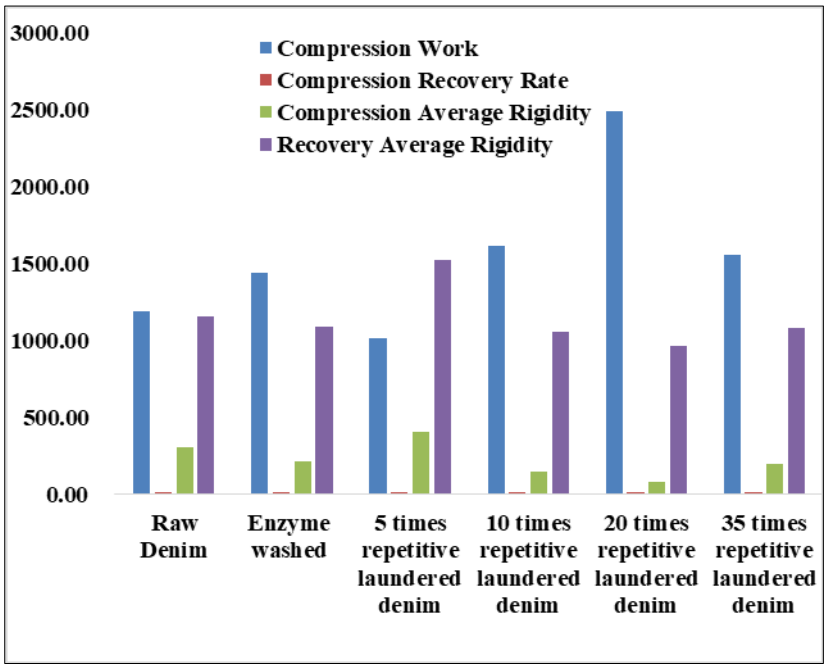

Figure 8 Compression property of inner surface VS repetitive laundered sample

Its seems that the surface friction coefficient in warp and weft direction results of all laundered sample has not that much significant variance, some sample shows similar value, but among all the sample 5 times repetitive laundered denim shows the most less coefficient in both surface and both direction, which means this sample can move freely under human skin and it will be less surface roughness (Fig 9).Along with friction properties 5 times repetitive

laundered denim shows the lowest amplitude and wave length in both direction and in both surface which indicates that it is less rough than the rest of the sample (Fig. 10).

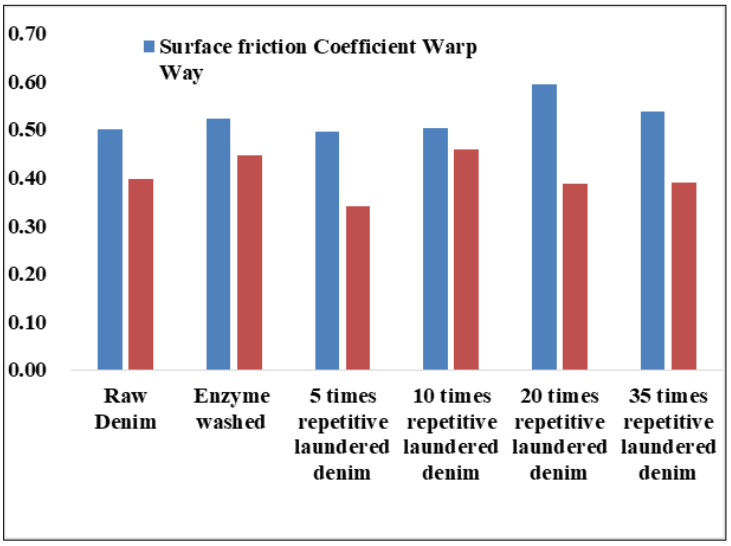

Figure 9 Friction property of outer and inner surface VS repetitive laundered sample

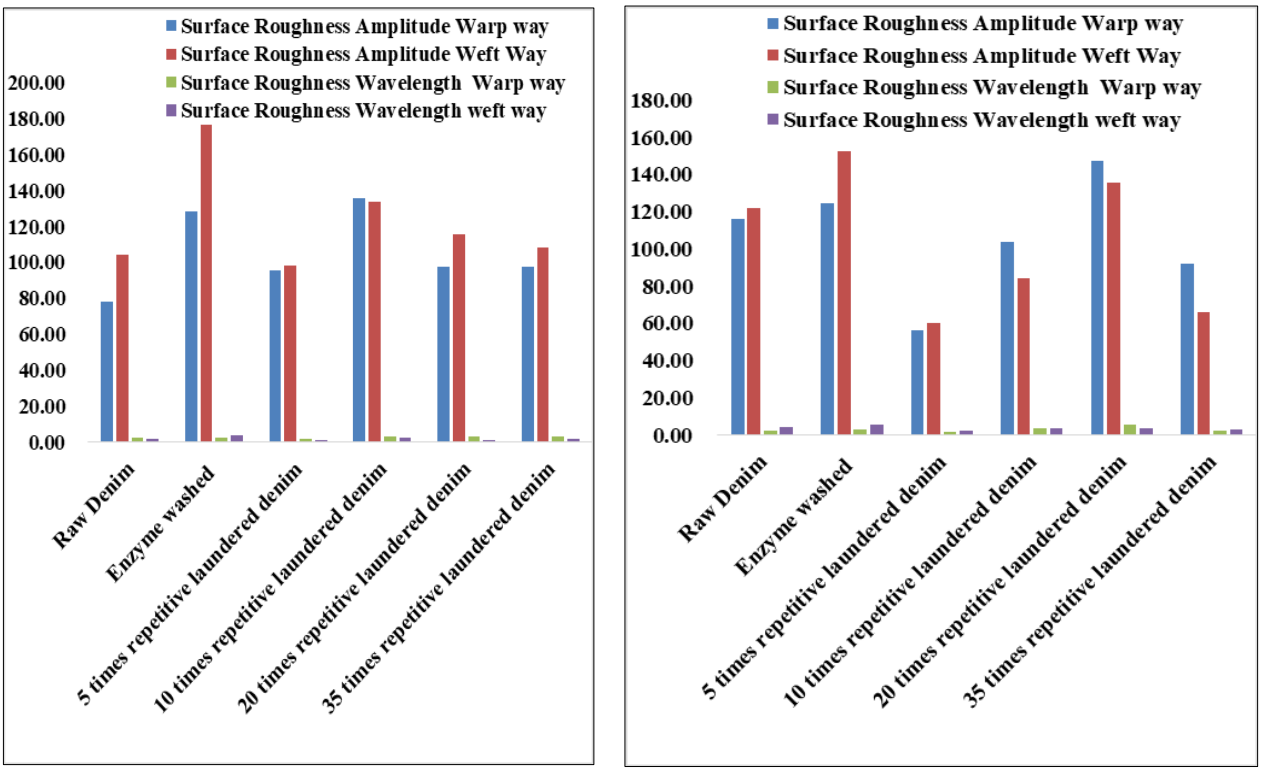

Figure 10 Roughness property-(A) outer surface VS repetitive laundered sample, (B) inner surface VS repetitive laundered sample

4. Conclusion

From the experiment result, it shows that 35 times repetitive laundered denim has lower EPI, PPI and air permeability property among all. In bending properties BAR of raw denim in both warp and weft way direction, it is decreases along

with BW bending work after desizing and enzyme wash because of the removal of sizing material and the removal of protruding fibre, influence of fabric softner is also resposible for the low bending rigidity of enzyme washed denim. In thermal properties in outer surface 10 times repetitive laundered denim shows minimum thermal conductivity and minimum thermal flux, which means, this sample will not flow the environment heat to the body due to the least thermal conductivity and heat flux during wearing and 35 times repetitive laundered denim shows the maximum thermal flux which represents the maximum coolness during wearing. In inner surface 20 times repetitive laundered sample shows minimum heat flux and conductivity which means this sample does not flow much heat from human body to the environment, it gives warmness and similarly like outer surface, 35 times repetitive laundered denim shows the maximum thermal flux which represents the maximum coolness during wearing. Its seen that the surface friction coefficient in warp and weft direction results of all laundered sample has not that much significant variance, some sample shows similar value, but among all the sample 5 times repetitive laundered denim shows the most less coefficient in both surface and both direction, which means this sample can move freely under human skin and it will shows less surface roughness.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have no competing interests.

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