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Seam Performance Evaluation of Plain Fabric Using Different Dyes in Garments Dyeing

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Abstract The seam performance, such as seam strength, seam slippage, and seam efficiency is an important factor of a garment. The durability of a garment depends on the longevity of a seam. Now a day's fabric is dyed in the form of garments. So, it should be known about the seam properties how can it influenced after dyeing. The seam strength and seam elongation are the important factor for some purposes of end use such as domestic, decorative, functional, and protective, etc. So this study compares the longevity of seam before and after dyeing with alternative four dyes (direct dye, reactive dye, vat dye and pigment color) applied on sewn 100% cotton woven plain fabric which sewn by white colored polyester core spun thread (40/2 Tex). Dyed and undyed garment panels (specimen) are prepared along to the both in warp and weft direction for testing. In both warp and weft direction five samples of each group were taken for testing. The testing procedure was followed according to the ASTM method; D1683-04 and D5034. Seam performance evaluated in three different stages as grey panel, pretreated panel and dyed panel. In this study Universal strength tester was used for evaluation seam strength and seam slippage. The study was performed by taken 6.0 mm seam slippage to measure the breaking load. It was observed breaking load of the undyed garment panel were show higher strength than the dyed garments without seam opening. Here also discussed in details that, seam strength, seam slippage and seam efficiency not only influenced sewing thread, fabric construction, needle size, sewing machine condition etc. also dyestuffs can influence seam properties.

Keywords Seam performance, Plain fabric, Dyed fabric, Breaking load, Universal strength tester

1. Introduction

The apparel industry generally produces a three-dimensional product from two-dimensional fabric. Apparel manufacturing process having some compulsory steps to finishing process in order to make a complete product. But stitch seaming is a common method that used world wide during converting garments from fabric (Solinger, 1989; Behera and Sharma, 1998). Seam found after stitching stage. And this seam is an important part of a garment, play an important role during wear. Seam strength, slippage, puckering, appearance has strongly influenced the seam performance and quality (Lindberg et al., 1960). A seam is generally formed by sewing machine and that should satisfy all the requirements of the end user (Rosenblad and Cednas, 1973; Stylios and Lloyd, 1990). From several studies, it clearly indicates that, seam is the most important parts of a garment and it is necessary to understand before apparel production. Seam quality insures by some aesthetic and functional performance after making a garment in the apparel industry. The functional performance includes strength, tenacity, efficiency, elasticity, elongation, flexibility, bending stiffness, abrasion resistance, washing resistance and dry cleaning resistance of the seam under some conditions of mechanical stress for a period of time (Mehta, 1985; Carr and Latham 1995; Glock and Kunz, 1995). Serviceability of apparel depends on seam strength, tenacity and efficiency. Seam should not be damaged during bending, shift and during folding. For this it should have proper elasticity, elongation, flexibility and low bending stiffness properties. Abrasion of seam also be found during wear, dry cleaning and washing. In this situation, it is expected that seam should have good abrasion and/ or washing and/ or dry cleaning. Consumer body as hand and eye also exhibits some aesthetic properties of a seam (Solinger, 1989; Carr and Latham, 1995; Glock and Kunz, 1995; Choudhory, 1995). A quality seam of a garment insures free from seam puckering, seam grin, distortion, unbalanced seam, loose seam, skipped stitches, etc. Faults free seam insure customer satisfaction and increase its acceptability. The apparel industry evaluates seam quality by using several dimensions from the consumer points of view (Kadolp, 1998).

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2. Aim of Study

To characterization of seam strength, seam slippage and shrinkage on cotton plain fabric before and after dyeing with different dyestuff like direct dye, reactive dye, vat dye and pigment dye.

3. Materials and Methods

3.1. Materials

a. Fabric

Woven cotton plain fabric ($\frac{117\times76}{33s\times27s}\times 59''$G.S.M = 154)

b. Sewing thread

100% Spun polyester sewing thread (count: 40/2 Tex; sewing thread ply: 2; colour: white; finish: lubricant finish; sewing thread length: 2200 meter).

c. Sewing needle

Needle size: metric 90; finish: chrome; point: thin ball (No.1/No. 23))

d. Dyestuffs

Direct dye, reactive dye, vat dye and pigment colour.

e. Equipments

Single needle lockstitch sewing machine, Sample dyeing machine and Universal strength tester.

3.2. Methods

a. Specimen Preparation

According to ASTM 1683-04 method, all samples was prepared. Each sample length was 350 mm and width was 100 mm. After that for seam preparation 200 mm length was marked and folded which length were 100 mm and sewn 2cm. Finally, the seam was prepared in both warp and weft direction.

b. Pre-treatment

The specimen was desized by neutral enzyme then scoured and bleached by using caustic and peroxide.

c. Dyeing Method

After pretreatment specimen were dyed with direct, reactive, vat dye and pigment colour by using sample dyeing machine.

d. Test Method

ASTM D1683-04 method was used to measure, seam strength, unseam strength, seam slippage and seam efficiency.

4. Results and Discussions

4.1. Measurement of Breaking Load and Seam Slippage for Grey and Pretreated Fabric

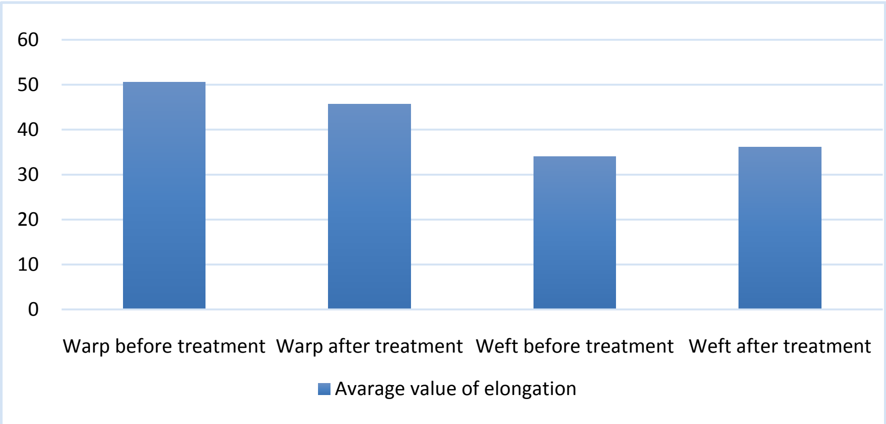

Figure 1. Measurement of breaking load in kgf for grey and pretreated fabric

Above figure, in the warp direction, the higher breaking load was required to break the grey unseam garments than pretreated garments, but in weft direction higher breaking load was required to break the pretreated unseamed garments than grey garments. So it is clear that, garments strength falls after pretreatment in the warp direction and garments strength increased in weft direction.

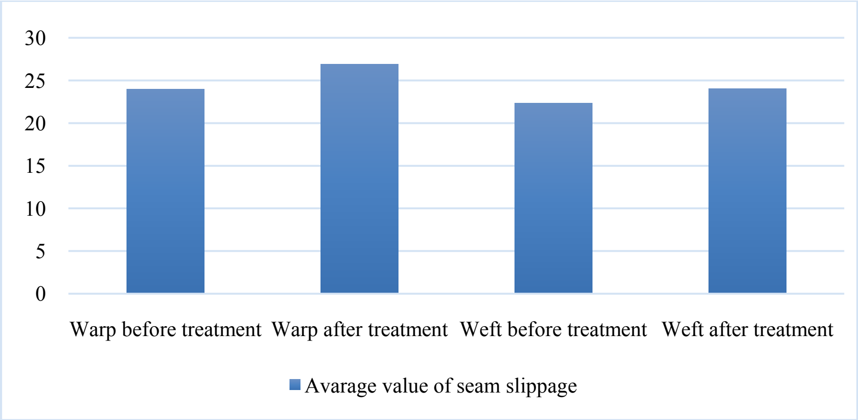

Figure 2. Measurement of seam slippage for grey and pretreated fabric

Above figure shows, breaking load (kgf) comparison for constant seam slippage (6.0 mm) of before and after pretreated garments. Here, treated garments seam slippage is greater than grey garments in warp direction. Similarly, in weft direction, seam slippage of untreated garments is less than treated garments. So, it is clear that seam slippage increased after pretreatment.

4.2. Measurement of Breaking Load and Seam Slippage for Pretreated and Dyed Fabric

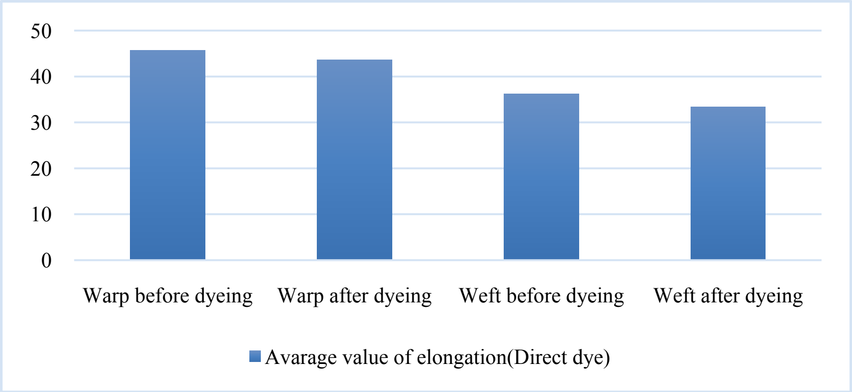

Figure 3. Measurement of breaking load in kgf for direct dyed fabric

From this observation, it is clear that the strength of unseam garments decreased after dyeing with direct dye in both warp and weft direction. Average breaking loads of pretreated unseam garment are higher than direct dyed garments. That means strength of direct dyed garments decreased in both warp and weft direction.

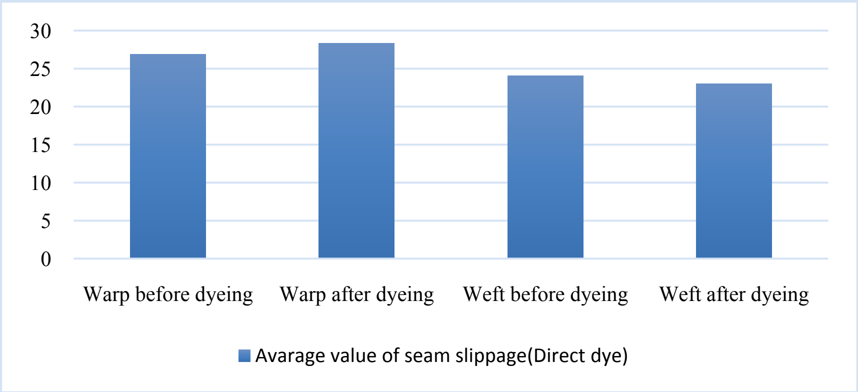

Figure 4. Measurement of seam slippage in mm for direct dyed fabric

From above graph, it shows the average seam slippage of pretreated and direct dyed garments. Here, seam slippage of direct dyed garments was lower than the pretreated garments in both warp and weft direction. That means after dyeing with direct dye seam slippage decreased.

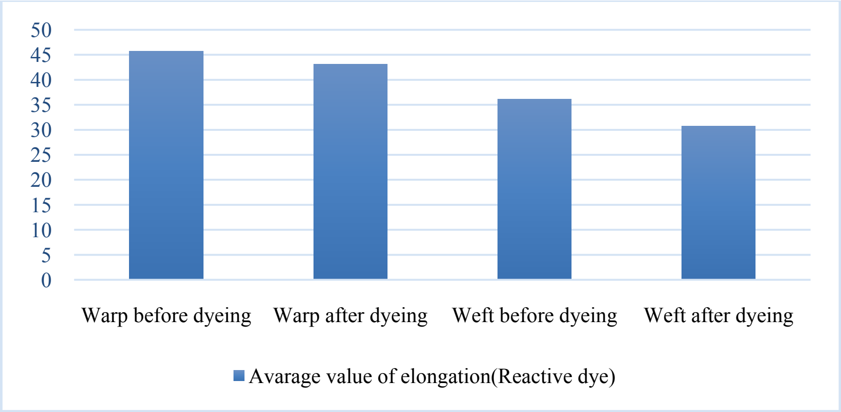

Figure 5. Measurement of breaking load in kgf for reactive dyed fabric

After dyeing with reactive dye, the strength of dyed garments lower than pretreated garments. The above graph explains that comparatively less breaking load required to break the reactive dyed unseam garments than pretreated unseam garments. It is clear that the strength of unseam garments decreased when dyeing with reactive dye.

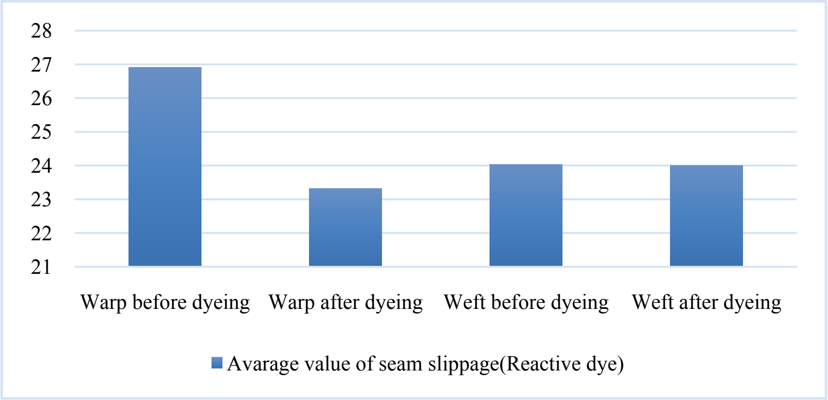

Figure 6. Measurement of seam slippage in mm for reactive dyed fabric

From the above graph, seam slippage of dyed garments is lower than pretreated garments When garments dyed with reactive dye the seam slippage decreased in both warp and weft direction.

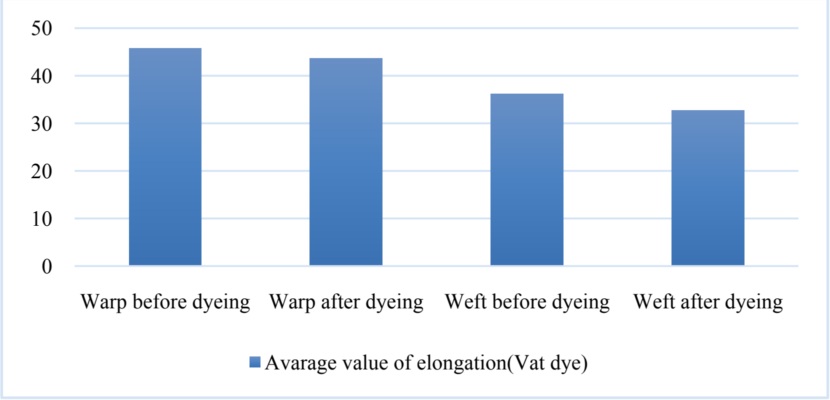

Figure 7. Measurement of breaking load in kgf for vat dyed fabric

The above figure shows the breaking load required to break the pretreated and vat dyed garments. The strength of vat dyed garments lower than pretreated garments. That means fabric strength decreased when the garments dyed with vat dye.

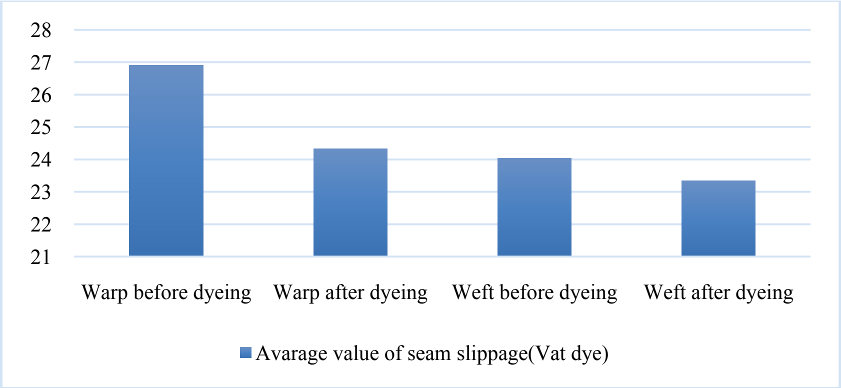

Figure 8. Measurement of seam slippage in mm for vat dyed fabric

From the figure, seam slippage of vat dyed garments is lower than pretreated garments. But the seam slippage in warp direction comparatively higher than other dyed garments. On the other hand, seam slippage of vat dyed garments was lower than pretreated garments in weft direction. So seam slippage in weft direction decreased when dyeing with vat dye.

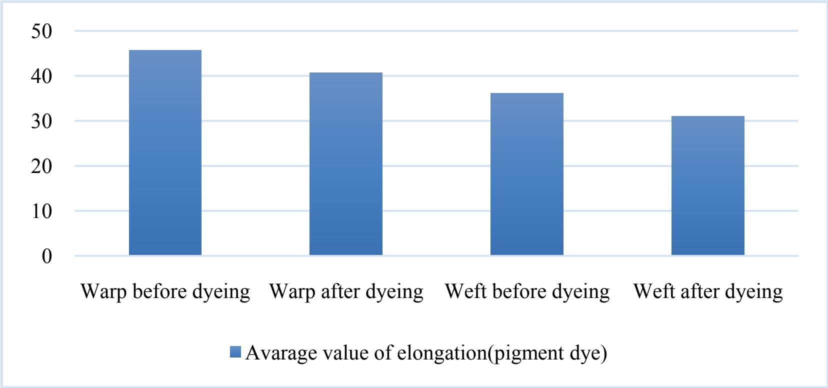

Figure 9. Measurement of breaking load in kgf for pigment coloured fabric

It is explained that the strength of pigment coloured garments decreased than pretreated garments in both warp and weft direction, that means lower breaking load required to break the pigment coloured garments than pretreated garments in both warp and weft direction. So, it is clear that garments fabric strength decreased when dyeing with pigment dye.

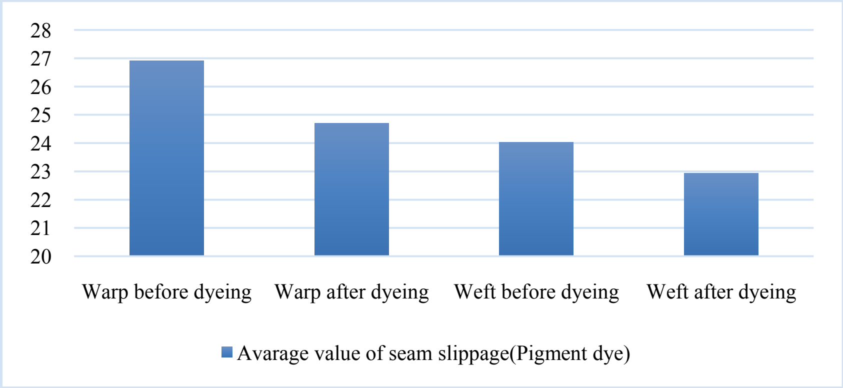

Figure 10. Measurement of seam slippage in mm for pigment dyed fabric

The above figure shows the data which explain the force required to open seam 6 mm. It is clear that seam slippage of pigment dyed garments less than pretreated garments in warp and weft direction. In both directions, seam slippage of pigment dyed garments is decreased.

4.3. Comparison between Seam and Unseam Fabric Strength

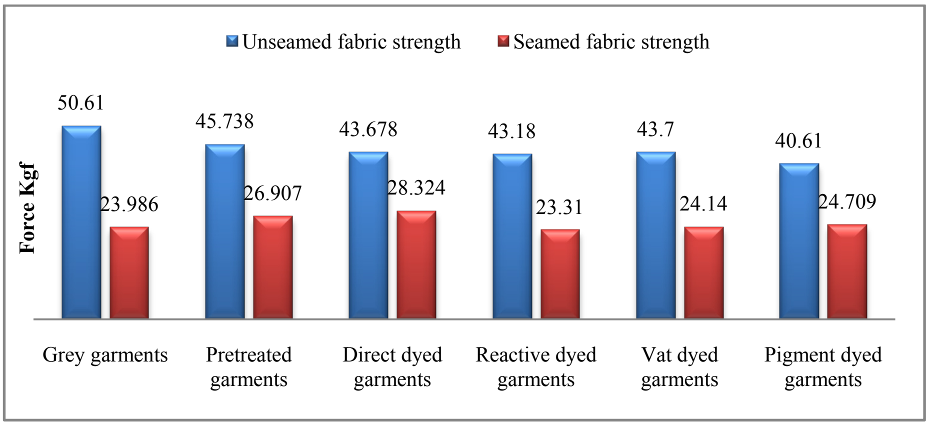

Figure 11. Comparison between seam and unseam fabric strength in warp direction

From the above figure, it is explained that unseam strength is higher in grey garments, but lower in pigment coloured garments and moderate strength found when dyed garments with other dyestuff. Similarly, seam strength is better in direct dyed garments, but lower in reactive dyed garments and strength of other dyed garments are moderate. The higher strength is shown by the pretreated garments before dyeing.

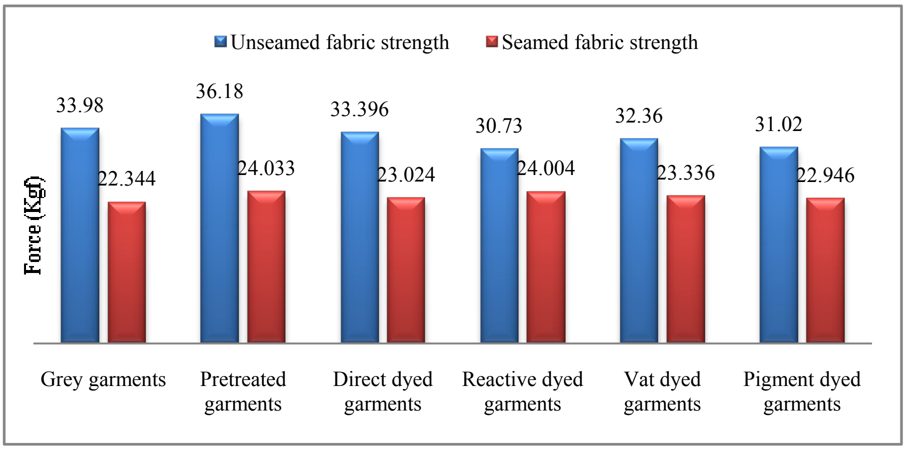

Figure 12. Comparison between seam and unseam fabric strength in weft direction

The figure shows that unseam strength is higher in pretreated garments where reactive dyed garments have lower strength and moderate strength found when dyed with other dyestuffs. Similarly, seam strength is better in pretreated garments, but lower in grey garments and dyed garments seam strength is moderate. After dyeing, seam strength of dyed garments always less than pretreated garments.

4.4. Comparison of Seam Efficiency of Fabric at Different Stages

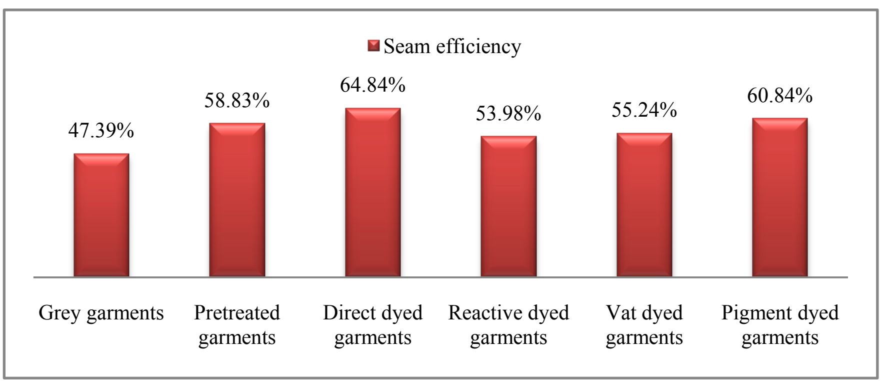

Figure 13. Comparison of seam efficiency at different stage in warp direction

The seam efficiency is the ratio of seam strength and the unseam strength. It is expressed as a percentage. When the seam strength value is equal or nearer equal to the unseam strength value, then seam performance will be better. It should not be less than 80%. From the figure, the efficiency of all seams have not more than 70%, which is not sufficient for good seam performance. Among all the seam efficiency is shown in the graph, only direct dyed garments show higher efficiency, the seam efficiency of pigment less than direct dye, strength of vat and reactive dyed garments are gradually decreased.

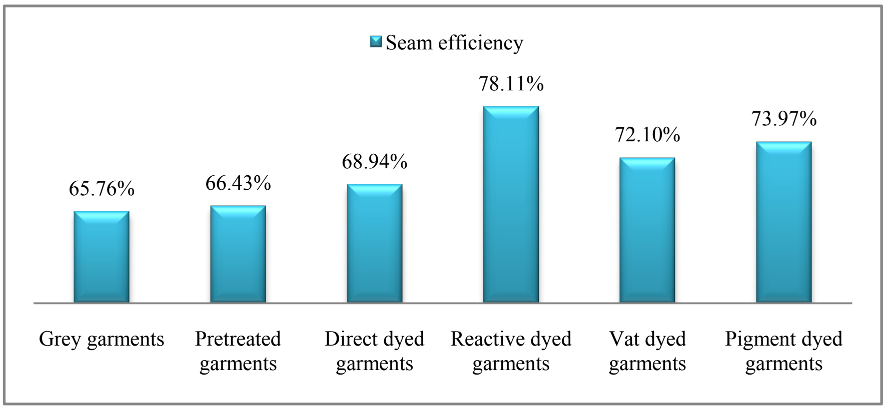

Figure 14. Comparison of seam efficiency at different stage in weft direction

From the figure, in weft direction reactive dyed garments shows better seam efficiency than other garments. Pigment coloured garments have good efficiency whilst warp direction also show good seam efficiency. Here, grey garments seam efficiency is lower than other seams. Pretreated garments, direct dyed garments and vat dyed garments show moderate seam efficiency.

5. Conclusions

From the study, it is shown that the spun polyester thread seam strength is not falling down in pretreated process and dyeing process with four dyes, i.e. direct dye, reactive dye, vat dye and pigment color. For these dyes, polyester thread does not absorb dye, but for using cotton fabric the strength is varied and in case of some dye strength is raised and some cases are falling down. Here also notice that the unseam strength was better in direct dye, good in vat dye, moderately good in reactive dye and pigment also in the warp direction, but in case of weft direction the unseam strength was good in direct dye, moderately good in vat dye, moderately in pigment color and also reactive dye. The seam strength was good in direct dye, moderate in pigment color, vat dye, reactive dye in the warp direction, but in weft direction seam strength was higher in reactive dye, slightly moderate in vat dye, direct dye and pigment color. The seam efficiency was found higher in direct dyed garments, after then the value of seam efficiency of pigment, vat and reactive dyed garments are gradually decreased along in the warp direction. The weft directional garments are dyed with reactive dye was given better seam efficiency, moderate in pigment color and vat dye but lower in direct dye. Some fabric properties as ends per inch, picks per inch, yarn count and weave type playing a major role in the performance of the seam. With increase EPI and PPI, increase cover factor that's show greater fabric strength and seam breakage.

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