Effect of different constructions of pretreated fabrics on easy care properties

Mohamed A. Ramadan*, Ahmed S. Montaser*, Ahmed M. F. Ahmed &Amira A. Elmahdi*****
***Textile Research Division, National Research Centre (ID: 60014618), Egypt.**
****Home economics department - Faculty of Specific Education - Fayum University**
*****Home economics department - Faculty of Specific Education - Mansoura University**

Abstract

This study investigates the effect of different textile structures on the easy care properties, some of the physical and mechanical properties of the cotton and blended fabrics, which contain different percentages of lycra in the weft yarn (4, 5.5 and 7%). The warp yarns were fixed for all the fabrics used in the research and the yarn number was 50/2 cotton 100%. Two types of materials were used for weft yarn (100% cotton, 50/50 cotton / polyester) and three different textile structures (plan 1/1, twill 2/2 and stain 4). The fabrics were processed with a vase containing 15% Fixaprite, 2% Citric Acid, 2% Magnesium Chloride, fixation Temperature 140 ° C and fixation time 2 min. The results showed that the fabric produced by 50/50 cotton / polyester yarn, 4% lycra, and twill textile structure is the best in terms of measuring the crease recovery angle in the direction of the weft and the warp, while if the ratio of lycra change to 5.5% and 7% A 50/50 weft of cotton / polyester plain 1/1 fabric was the best. In the case of tear resistance, the best fabric was made with 100% cotton yarn and with an Atlas 4, regardless of the ratio of lycra. While in the case of whiteness the best was the fabric produced by 50/50 cotton /

polyester yarn and plain 1/1 however the ratio of lycra changed. The results disclosed that the fabric produced by 50/50 cotton / polyester yarn with different lycra and the textile structure of 1/1 plain gave the highest tensile strength and elongation percent when compared to other fabrics. For weight per square meter, the fabric produced with 100% cotton yarn and lycra 5.5% and 7% and the 1/1 fabric structure is the highest weight per square meter.

Introduction

Easy care textiles are now available in the market. It can be achieved during either treatment or care. Incorporation of Easy care agents during the treatment, such as cyclodextrins [1], elastomer latex/synthetic resin emulsions [2] ,thermoplastic microcapsules [3] ,and coating compositions [4-7],were reported to bring about textile goods.

Polycarboxylic acid is quite effective for anti-wrnikle treatments for cotton fabric by replacing the conventional formaldehyde-type treatment resin, polycarboxylic acid forms a five-membered cyclic anhydride intermediately in the presence of a catalyst and then produces an ester bond with R-OH [8, 9]. The many hydroxyl bonds on the cellulose fiber structure can form ester bonds with poly carboxylic acid and crosslink [9,10]. Carboxylic acid used as a crosslinking agent to study the antimicrobial treatment of woolen fabrics through the mixture of citric acid with biopolymer chitosan [10,11]. With the above in mind, the present research is undertaken the treatment of different textile structures (plan 1/1, twill 2/2 and stain 4) of the cotton and blended fabrics, which contain different percentages of lycra in the weft yarn (4, 5.5 and 7%) by 15% Fixaprite, 2% Citric Acid, 2% Magnesium Chloride, fixation Temperature 140 °C and fixation time 2 min. Also this manuscript deals with effect of the treatment on the easy care properties, some of the physical and mechanical properties. Fixaprite molecule bonds with cellulose molecule using citric acid and magnesium chloride as catalyst via crosslinking. The modified fabric brought about under such condition will enjoy ease of care properties. Some investigations such as crease recovery angle, whiteness index, tear resistance, tensile strength and elongation carries out for the treated fabrics.

Experimental

Weight loss (%) in fabric weight was calculated from the difference of in fabric weight before and after the treatment.

Tensile strength and elongation at break was determined by the strip method according to ASTM D 1682-64.

Whiteness index was evaluated with a Color-Eye 3100 Spectrophotometer from SDL Inter (Welch & Peters, 1997).

Standard method was used to measure wrinkle recovery angles (AATCC test method 66-1984).

Tear strength was measured according to ASTM D 2261-96.

SEM was studied using a scanning electron probe micro-analyzer

Results and discussion

Effect of pretreatment process on easy care properties of different fabric constructions under study (as selected group) was visualized by applying optimum condition on two types of weft threads or two blended fabrics (cotton and cotton polyester) and three simple weaving constructions were used (plan, Twill and Stain). All the previous constructions applied on three ratios of lycra (4, 5,5 and 7%). The optimum conditions applied to cotton fabrics (fixapret, 15g. /100 ml, $Mgcl_2$, citric acid: 2g/100 ml, curing temperature 140 °C and curing time 2 minutes). These optimum conditions previously applied to cotton fabrics

suggested to apply on different constructions of fabric in the current study. The effect of different constructions of pretreated fabrics on easy care properties was reflected on the following properties physical properties and mechanical properties as follow:

Effect of fabric construction on crease Recovery angle with different percent of Lycra

Primarily, all fabrics produced from blended twill fabrics containing 4, 5 and 7 % Lycra express high weft crease recovery angle (CRA).

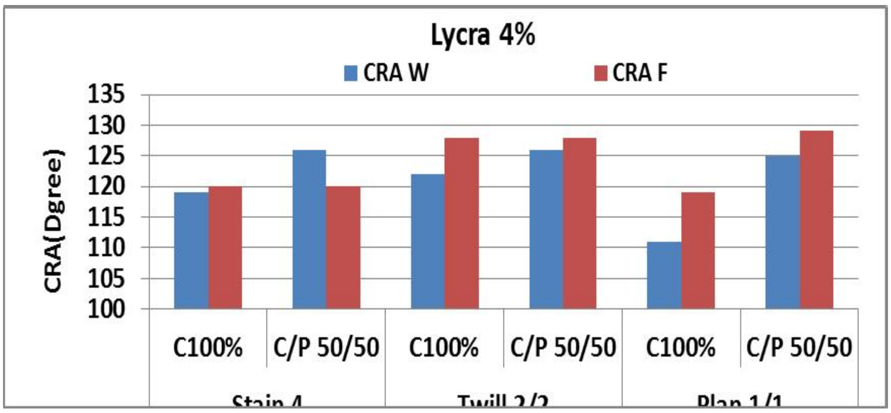

Figure 1: Influence of fabric construction with different types of fabric on crease recovery angle in presence of 4% Lycra.

From Figure 1 we can conclude that, Blended Plan fabric shows the highest weft crease recovery angle and higher than cotton fabrics. Blended twill fabric shows significant difference from cotton 100%; while warp crease angle of blended twill sample shows higher values than cotton. For Stain fabrics warp crease recovery angle more than weft crease recovery angle regardless type of weft yarn material. This due to the increase of flouting warp yarns in longitudinal direction.

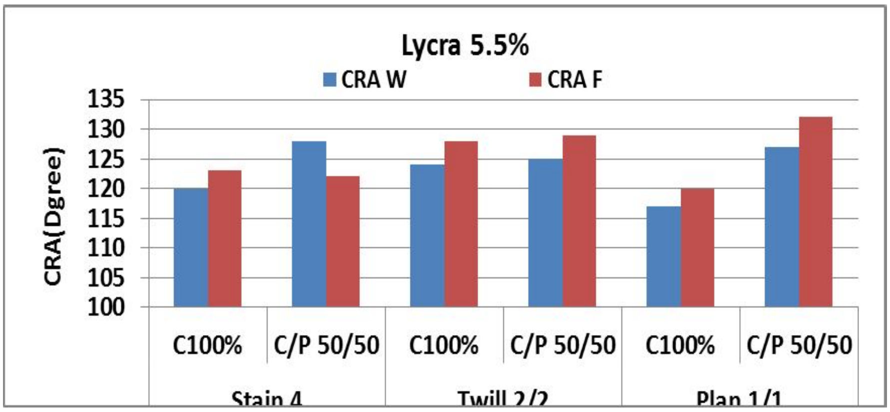

Figure 2 : Effect of fabric construction on crease recovery angle in presence of 5% Lycra

The results of figure 2 show that, Plan Blended fabrics has higher crease recovery angle in comparison with Plan cotton fabrics at the warp and weft direction. While weft crease recovery angle of twill blended fabric shows higher value than warp crease recovery angle for twill cotton fabric. In the case of stain fabrics, stain blended fabrics manifest higher account of crease recovery angle than stain cotton in warp direction and vice versa in weft direction). Plan 1/1 blended fabric containing 5.5% lycra expresses high crease recovery angle at all directions in comparison with all types of fabrics.

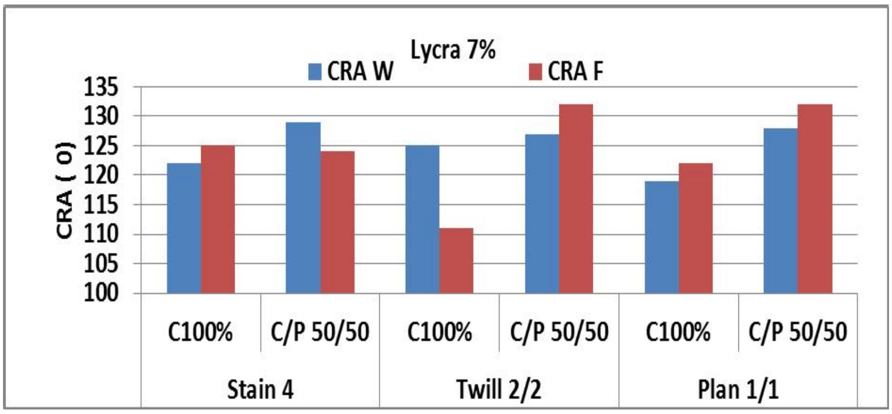

Figure 3: Influence of fabric construction on crease recovery angle in presence of 7% Lycra

As present in figure 3 the plan blended fabrics exhibiting superior values at crease recovery angle at all directions in comparison with plan cotton fabrics. Weft crease recovery angle of twill blended fabrics express higher results than weft crease angle of twill cotton. Stain blended cotton exhibit chief results in comparison with stain cotton at weft crease recovery angle examination. Finally, Plan 1/1 blended fabrics containing 7% lycra characterized by maximum values at crease recovery angle regardless direction of CRA.

Effect of fabric construction on Tear resistance angle with different percent of lycra .

Basically, Tear resistance experiments shows high results at warp direction for all fabrics constructions containing 4, 5,5 and 7% of lycra, while stain 4 cotton 100% express the highest value of tear resistance at warp and weft directions .

Table 1: Influence of fabric construction on tear resistance in presence of 4% Lycra.

Lycra %	Construction	Sample	Tear Resistance (kg)	
			W	F
4	Stain 4	C 100%	39.6	8.9
		C/P 50/50	38.2	7.6
	Twill 2/2	C 100%	38.2	7.7
		C/P 50/50	36.2	7.4
	Plan 1/1	C 100%	37.4	7.5
		C/P 50/50	36.3	7.3

As shown in table 1. Tear resistance of Plan 1/1 blended cotton shows lower value than cotton 100% at all directions whatever warp or weft. Twill 2/2 cotton 100% fabric expresses high result in comparison with blended cotton at warp and weft directions. Stain cotton fabric shows higher results at tear resistance than blended cotton at all directions. All in all, Stain cotton containing 4% lycra shows maximum value over all other fabric constructions.

Table2: illustrate the tear resistance of different fabric constructions containing 5.5% lycra.

Lycra %	Construction	Sample	Tear Resistance (kg)	
			W	F
5.5	Stain 4	C 100%	39	8.5
		C/P 50/50	37.4	7.5
	Twill 2/2	C 100%	37.5	7.5
		C/P 50/50	36.2	7.4
	Plan 1/1	C 100%	37	7.2
		C/P 50/50	36.1	7.2

From table 2: Plan 1/1 blended cotton fabrics show lower value of tear resistance at all directions whatever warp or weft. While twill cotton fabrics show higher value than twill blended fabrics at all directions also. Further, stain 4 cotton shows higher values than blended cotton fabrics at warp and weft directions.

Table 3: Influence of fabric construction on tear resistance in presence of 7% Lycra

Lycra %	Construction	Sample	Tear Resistance (kg)	
			W	F
7	Stain 4	C 100%	37	8
		C/P 50/50	37	7.5
	Twill 2/2	C 100%	36	7
		C/P 50/50	36.2	7.2
	Plan 1/1	C 100%	35.4	6.8
		C/P 50/50	36.0	7.1

Table 3 illustrate that, Plan blended cotton fabrics shows higher value of tear resistance at weft and warp directions than cotton fabrics. While twill blended cotton fabrics shows higher value than twill cotton fabrics at weft and warp direction. Further, plan cotton fabric shows smallest value of tear resistance at weft and warp direction. However, stain blended fabrics shows identical results of tear resistance at weft direction with stain cotton fabrics at warp direction.

Effect of fabric construction on Whiteness Index with different percent of lycra.

Chiefly, plan blended cotton fabrics showed higher whiteness index than cotton fabrics at all fabric constructions containing 4, 5.5 and 7% lycra.

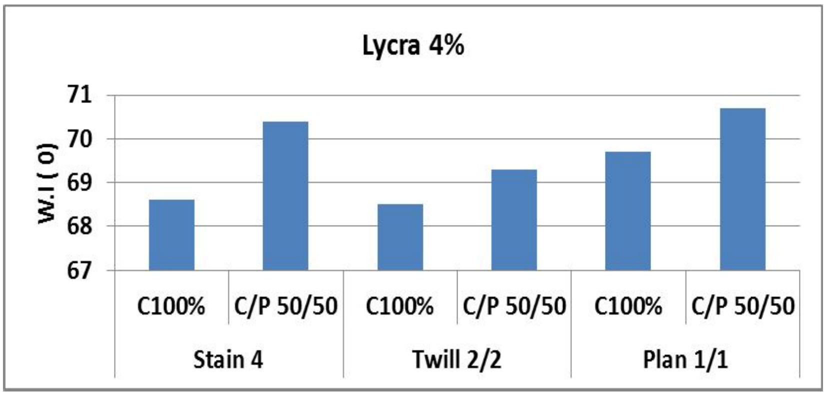

Figure 4: Influence of fabric construction on Whiteness Index in presence of 4% Lycra

Plan blended cotton fabrics shows higher value at whiteness index than cotton fabric. While twill blended cotton fabrics shows higher value than twill cotton fabrics of whiteness index. Further, stain blended cotton shows higher values of whiteness index cotton fabrics at warp direction. Plan bended cotton fabric has the highest Whiteness index (Fig. 4).

As mentioned before, blended cotton fabrics at all constructions achieved the highest whiteness index over cotton fabrics at samples containing 5.5.% lycra. Whiteness index of plan bended cotton fabric is the same for stain blended cotton fabric nearly (Fig. 5).

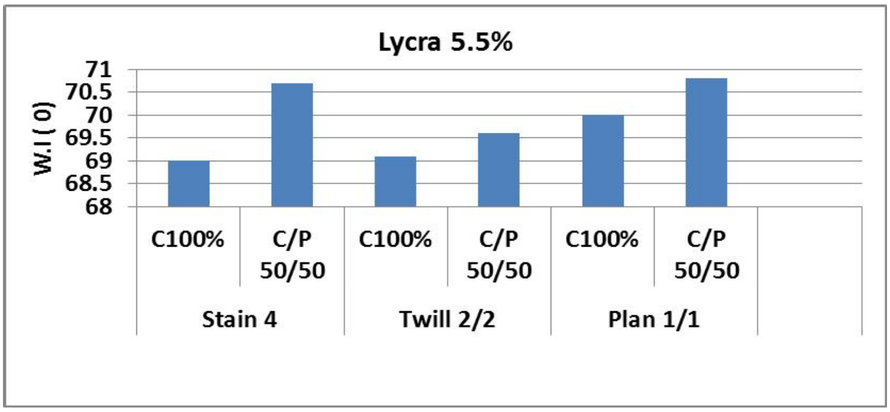

Figure 5: Influence of fabric construction on whiteness index in presence of 5.5% Lycra

From figure 6, blended cotton fabrics at all constructions achieved the highest whiteness index at samples containing 7% lycra. Plan bended cotton fabric has the highest Whiteness index .

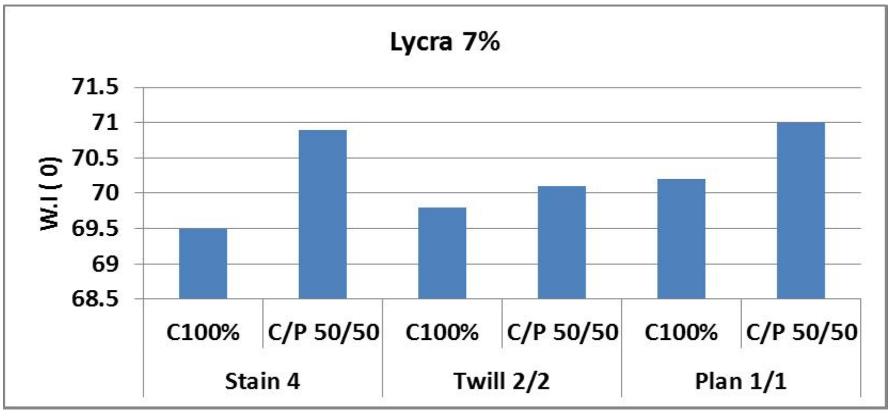

Figure 6: illustrate the whiteness index of different fabric constructions containing 7% lycra.

Effect of fabric construction on tensile strength with different percent of lycra .

Principally, the warp tensile strength results shows higher results that weft tensile strength results at all fabric constructions whatever the lycra percent exhibited at the fabrics. The best fabric construction for tensile strength depends on lycra percent and direction of the applied force on fabric under examination, for instance plan blended fabrics shows the highest tensile strength at warp and weft directions for all fabric constructions containing 4% lycra (table 4). Plan 1/1 blended fabrics shows the highest tensile strength at weft and warpdirections for all constructions containing 5.5 % lycra as shown in table 5. Furthermore, plan blended cotton fabrics shows the highest tensile strength in both directions for all constructions containing 7% lycra as shown in table 6.

Table 4: illustrate the tensile strength of different fabric constructions containing 4% lycra.

Lycra %	Constructio n	Sample	Tensile Strength (kg)	
			W	F
4	Stain 4	C 100%	64	10
		C/P 50/50	59	11.5
	Twill 2/2	C 100%	66	10.2
		C/P 50/50	66	11
	Plan 1/1	C 100%	71	11.2
		C/P 50/50	72	11.2

Table 5: Influence of fabric construction on tensile strength in presence of 5.5% Lycra.

Lycra %	Construction	Sample	Tensile Strength

			(kg)	
			W	F
5.5	Stain 4	C 100%	62	9.5
		C/P 50/50	56	11.1
	Twill 2/2	C 100%	65	10.1
		C/P 50/50	60	10.9
	Plan 1/1	C 100%	69	11
		C/P 50/50	70	11.1

Table 6: Influence of fabric construction on tensile strength in presence of 7% Lycra

Lycra %	Construction	Sample	Tensile Strength (kg)	
			W	F
7	Stain 4	C 100%	60	9.0
		C/P 50/50	54	11.0
	Twill 2/2	C 100%	62	9.8
		C/P 50/50	57	10.8
	Plan 1/1	C 100%	65	10.8
		C/P 50/50	66	10.9

Effect of fabric construction on Elongation at break with different percent of lycra .

Basically, elongation test shows high results at weft direction for all fabrics constructions containing 4, 5,5 and 7% of lycra. Plan blended cotton fabrics show the highest value of elongation regardless type of constructions and lycra percent.

Table 7: Influence of fabric construction on Elongation at break in presence of 4% Lycra

Lycra %	Construction	Sample	E. at break (%)	
			W	F
4	Stain 4	C 100%	11.0	51.2
		C/P 50/50	11.0	51.5
	Twill 2/2	C 100%	10.8	51.2

		C/P 50/50	11.3	52.1
	Plan 1/1	C 100%	11.4	51.5
		C/P 50/50	11.6	52

Plan blended cotton fabrics shows higher value at elongation than cotton fabric at weft and warp directions. While twill blended cotton fabrics shows higher value at both warp and weft directions than twill cotton. Further, stain blended and cotton fabrics shows the same value at warp direction and stain blended cotton fabrics shows pit higher than twill cotton fabrics at weft direction (table 7).

Table 8: Influence of fabric construction with different types of fabric on Elongation at break in presence of 5.5% Lycra

Lycra %	Constructio n	Sample	E. at break (%)	
			W	F
5.5	Stain 4	C 100%	11.2	51.2
		C/P 50/50	11.2	51.5
	Twill 2/2	C 100%	11.0	51.2
		C/P 50/50	11.6	52.9
	Plan 1/1	C 100%	11.5	52.8
		C/P 50/50	11.7	52.9

Plan blended cotton fabrics shows higher value at elongation than cotton fabric at both directions. While twill blended cotton fabrics shows nearly equally value at both warp and weft directions with plan blended fabrics. Further, stain blended and cotton fabrics shows the same value at weft direction as shown in table 8.

Table 9: Influence of fabric construction with different types of fabric on Elongation at break in presence of 7% Lycra

Lycra %	Construction	Sample	E. at break (%)	
			W	F
7	Stain 4	C 100%	11.4	52.0
		C/P 50/50	11.2	52.1
	Twill 2/2	C 100%	11.1	51.5

		C/P 50/50	11.8	52.7
	Plan 1/1	C 100%	11.7	52.8
		C/P 50/50	11.9	52.9

Plan cotton fabrics shows higher value of elongation at break percent than cotton fabric at weft direction and plan blended cotton fabric shows higher results at warp and weft directions. While twill blended follows plan blended fabric in the sequence. Further, stain cotton shows higher value than blended stain blended cotton fabrics at warp direction .

Effect of fabric construction on Meter Square Weight with different percent of lycra .

From figures 7, 8 & 9, meter square weight (MSW) of cotton fabrics more than blended cotton fabrics regardless the fabric construction type and lycra percent. This due to cotton fabric absorbency is higher than blended cotton fabrics. Cotton stain fabrics are the heaviest to meter square weight in presence 4% lycra (Fig. 7), while in presence 5.5% lycra the higher MSW is cotton plan1/1 fabric(Fig.8) The same holds true in case 7% lycra (Fig. 9).

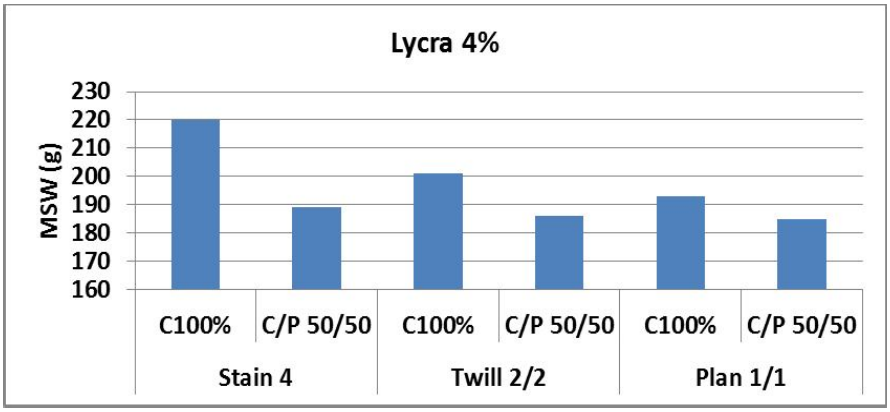

Figure 7: illustrate MSW of different fabric constructions containing 4% lycra.

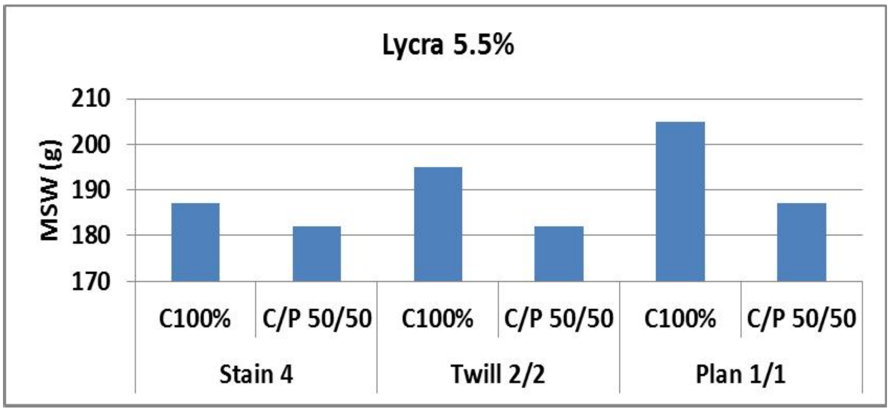

Figure 8: illustrate MSW of different fabric constructions containing 5.5% lycra.

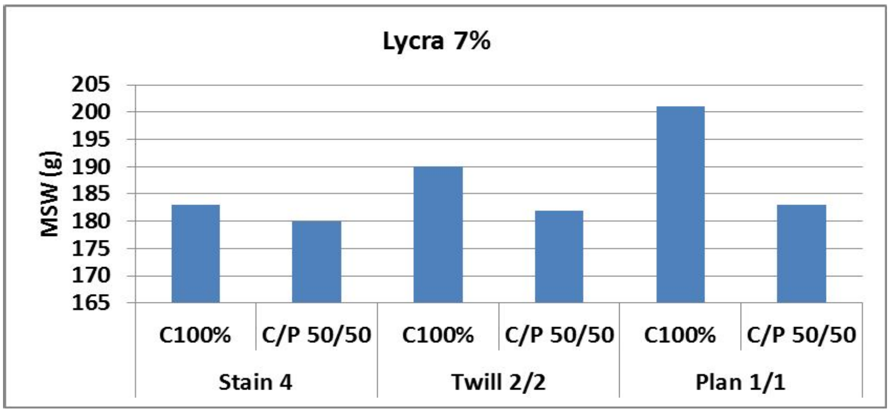

Figure 9: illustrate MSW of different fabric constructions containing 7% lycra.

References

[1] Bushman HJ, Knittel D, Schollmeyer E. Resin finishing of cotton in the presence of cyclodextrins for depositing fragrances. Melliand Textilberche 1991;72:E 75-76.

[2] Omi Kenshi Spining Co., Ltd. Fragrant Fabrics. Japan Kokai Tokyo Koho JP 59 150 171, 28 May,1984. CA 101, 19362v,1984).

[3] Kitagwa Y, Hoshikawa R (Matsuiskikiso Kagaku Kogyosho). Imparting lasting fragrance to

fabrics and fragrant fabrics. Japan Kokai Tokyo Koho JP 06 316 875, 15 November, 1984.

[4] Kuwamura S, Suzuki T (Dainippon Ink and Chemicals, Inc.). Japan Kokai Tokyo Koho JP 02

247255, 03 October, 1990.

[5] Synthesis of Nano-Sized Zinc Oxide and Its Application for Cellulosic Textiles, M.A.Ramadan, S.H.Nassar1, A.S.Montaser, E.M.El-Khatib1and M.S.Abdel-Aziz, Egyptian Journal of Chemistry 59,4,2016

[6] Effect of post-and pre-crosslinking of cotton fabrics on the efficiency of biofinishing with cellulase enzyme, A Hebeish, M Hashem, N Shaker, M Ramadan, B El-Sadek, MA Hady Carbohydrate polymers 78 (4), 953-960, 2009

[7] A Novel Approach to Incorporation of Chitosan in Cotton for Improving Fabric Performance, M. A. Ramadan, S. Sharaf, M. M. Abdel-Hady and A. Hebeish, The seventh International Conference of Textile Research Division, NRC, 2010 and Research Journal of Textile & Apparel 17 (2013), 61-74, 2010

[8] Martel B, Weltrowski M, Ruffin D, Morcellet M. Polycarboxylic acids as crosslinking agents for grafting cyclodextrins onto cotton and wool fabrics: Study of the process parameters. J Appl Polym Sci 2001;83:1449-1456.

[9] Hsieh HS, Huang ZK, Huang ZZ, Tseng ZS. Fabrics cured with citric acid and chitosan. J Appl Polym Sci 2004;94:1999-2007.

[10] Hebeish A, Abo-Shosha MH, Hilw ZH. 2nd international conference of textile research division NRC, Cairo, Egypt, April, 2005.

[11] E. M. El-Khatib and M. A. Ramadan / EEST Part A: Energy Science and Research 23 (2009) 39-47