

## IMPROVEMENT OF SOME EGYPTIAN COTTON FABRIC PROPERTIES BY SOME CHEMICAL TREATMENTS

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### Abstract

Improvement of some properties of both bleached and /or mercerized Egyptian Giza 89, and Giza 80 cotton fabrics using acrylic acid (AA), as a finishing agent in the presence of potassium peroxodisulphate solution ( $K_2S_2O_8$ ), and sodium dihydrogen phosphate ( $NaH_2PO_4$ ) in a combination employing a bad-dry-cure technique, followed by The addition of known concentration of chromium salt ( $K_2Cr_2O_7$ ), or an amine salt (tetra methyl ammonium chloride), as a UV protection agents in the dyeing bath was studied. To produce most balanced improvement in the fabric properties, the samples were treated with AA (8%), at pH 5-7, batching time 20-45 minutes, followed by drying of the batched samples at 95°C for 5 minutes, then curing at 140°C for 90 seconds. The factors affecting the cotton fabric properties such as pH, batching time, cotton fabric pretreatment, and AA finishing on tensile strength, elongation%, dyeing and fastness properties were studied. Also, the effect of chromium and amine salts on the UV protection value was studied. The results obtained revealed that the major improvements in the cotton fabrics were: weight gain, basic dye uptake (K/S) value, high fastness properties, high tensile strength and elongation%, and high UV-protection value. It has been noted that the mercerized Giza 89 shows good properties than the other treated samples.

Keywords: Egyptian cotton, Acrylic acid, UV agents, tensile strength, color strength.

### INTRODUCTION

Finishing of cotton textiles using dimethyloldihydroxyethyleneurea (DMDHEU), results in some odd disadvantages in respect of relatively poor tenacity retention abrasion resistance and lowering in whiteness index despite significant improvement in wrinkle recovery (Cheng-Chi Chen, 1990).

In a previous work, the use of polycarboxylic acid as substitute finishing agents to be much more perspective in this respect in view of their environmental friendly and nontoxic character was investigated (Saleh *et al.*2002). Finishes based on polycarboxylic acids can not improve tear strength, abrasion resistance, stiffness, and moisture regain characteristics of cotton fabrics.

Finishing of cotton using dialdehydes was reported by (Choi 2002). Ultimate crosslinking consequence to application of polymerizable acid such as acrylic acid

( $\text{CH}_2=\text{CH COOH}$ ), under the influence of appropriate catalysts may turn out to be more prospective in respect of all round property improvement or improved property balance. Results of related studies in the presence of  $\text{K}_2\text{S}_2\text{O}_8$ , and  $\text{NaH}_2\text{PO}_4$  were reported by (Das *et al.* 2000).

The complex process of weathering requires that textile should be protected against heat, UV, microorganism, rain and air pollution. Degradation of textile by UV light varies considerably and influenced by such factors as temperature, humidity, chemical structure of fiber, and the dyes applied to it (Tyronel 1997). Photostabilizers prevent or minimize this degradative process for fiber and for other polymeric substrates, and are classified into four groups (Mckellar *et al.*1979).

It was found that, (4-methoxy-benzylidene)-(3-methoxyphenyl)-amine showed a UV-blocking effect at UV-B band (Choi *et al.*, 2002). New approach for improving UV-protecting properties of woven cotton fabrics has been described by Ibrahim, *et al.* (2005). The fluorescence of unprotected white cotton fabrics has also been described (Ana 2004).

In a recent publication, the use of chicken feather wastes as a natural source of active amino acids after alkali treatments with 0.95N NaOH solution in the textile industry by the applying chicken feather onto both Giza 89, and Giza 90 Egyptian cotton fabrics was described. The finished fabrics showed high tensile strength strength, more dyeing uptake, and more reduction of the transmitted UV as compared to the untreated samples (Khaled *et al.* 2006).

The present work aims to improve some properties for both Giza 89, and Giza 80 bleached and/or mercerized Egyptian cotton fabrics using acrylic acid (AA), as a finishing agent in the presence of potassium peroxydisulphate solution ( $\text{K}_2\text{S}_2\text{O}_8$ ), and sodium dihydrogen phosphate ( $\text{NaH}_2\text{PO}_4$ ) in combination employing a bad-dry-cure technique, followed by the addition of known concentration of  $\text{K}_2\text{Cr}_2\text{O}_7$  or tetra methyl ammonium chloride, as UV protection agents

## MATERIALS AND METHODS

### Materials

Unbleached plain weave of Egyptian cotton fabrics namely Giza 89, and Giza 80 purchased from El-Nasr for spinning and textile Company- El-Mehalla, Egypt, during the crop season 2003-2004 were used for the present study. All chemicals used were of analytical grade using doubly distilled water ( $18.5 \text{ M}\Omega\cdot\text{cm}^{-1}$ ). NaOH was analytical grade (Koch-Light Co.). Hydrogen peroxide (30%. LR grade) from Aldrich. Sodium carbonate (LR grade), sodium silicate (136Tw, 27%  $\text{SiO}_2$ ), the wetting agent was the commercially Triton-X100 supplied by Merck. The hydrogen peroxide bleach

liquor for each bleaching process was analyzed by titration with potassium permanganate.

#### ***Scouring, bleaching and mercerizing treatments***

Scouring of the cotton fabric samples was performed by the pad-steam technique by padding the fabric with 10% sodium hydroxide containing 1.5-2% of Triton 100 in a two-bowel padding mangle adjusting the squeeze pressure to enable wet pick-up of 100%. The fabric was subsequently steamed in a laboratory steamer at 100°C for 10 minutes. The scoured fabric was washed with water, neutralized with dilute acetic acid, further washed with water, and finally dried in air.

Unbleached cotton fabrics were immersed in an alkaline bleach liquor (180 ml deionized water) containing sodium carbonate (0.2 g/l), sodium hydroxide (1.5 g/l), sodium silicate (0.4 g/l), magnesium sulphate (0.2 g/l), wetting agent (0.5 g/l) and hydrogen peroxide ( $10 \text{ ml}^{-1}$ ) was added to the bleaching liquor. The samples were removed from the liquor and neutralized with aqueous solution containing 0.1% acetic acid, followed by a through hot water (80-85°C) washing to ensure removal of residual chemicals. Samples were dried in an oven at 100°C for 60 minutes.

The bleached cotton fabrics were treated with aqueous solution of NaOH (20%) at room temperature. The samples were removed from the liquor and neutralized with aqueous solution containing 0.1% acetic acid, followed by a through hot water (80-85°C) washing to ensure removal of residual chemicals. Samples were dried in an oven at 100°C for 60 minutes.

#### ***Application of acrylic acid (AA) on the cotton fabric***

Presoaking of Giza 89, and Giza 80 Egyptian cotton fabrics (bleached, scoured, or/and mercerized) with 1% of  $\text{K}_2\text{S}_2\text{O}_8$ , and subsequent application of acrylic acid on the pre-soaked cotton fabric were performed separately by padding- technique according to (Welch *et al.* 1997). After two successive dipping in the acrylic formulation, the pressure between the squeezing roll enabled an overall wet pick up of 100%. The monomer solution was usually adjusted to the required pH by the addition of required dose of sodium carbonate ( $\text{Na}_2\text{CO}_3$ ). The aqueous monomer formulation usually contained a known dose of  $\text{NaH}_2\text{PO}_4$  as the esterification catalyst. The padded squeezed fabric was allowed to stand at 30°C for different time periods before they were subjected to drying in an oven at 95°C for 5 minutes. The dried fabrics were then cured at 140°C for 5 minutes. The mechanism of modification of cotton with AA under the influence of  $\text{K}_2\text{S}_2\text{O}_8$  used as the catalyst involves a free radical polymerization and graft copolymerization of AA on cotton, and  $\text{NaH}_2\text{PO}_4$  acts as the esterification catalyst (Das *et al.* 2000).

***Dyeing bath of the cotton fabrics containing UV protective agents***

The cotton fabrics finished with acrylic monomer were dyed using Remazole blue as a reactive dye (4% on weight of fabric), in the presence of known concentration of  $K_2Cr_2O_7$  or tetra methyl ammonium in the dyeing bath at 80°C for 90 minutes under stirring conditions. The pH of the dye bath was adjusted to pH 4 after completion of dyeing. The fabrics were washed with water and air dried.

***Evaluation of the properties of the treated fabrics******Measurements of dyeability***

K/S of the treated samples using the untreated samples as blank was determined using Perkin Elmer Spectrophotometer, Model Lambda 35 equipped with integrated sphere according to Kubelka-Munk equation:

$$K/S = [(1-R)^2/2R]$$

***Tensile strength properties***

The tensile strength (g/tex) and elongation% (%) were measured according to ASTM D412-98a using Zwick testing machine of model Z010 and equipped with 10Kn load cell and the testing was conducted at speed of 100mm/min. The results obtained were based on an average of ten tests in the wrap direction of each sample.

***Fastness properties******(a) Washing fastness (WF)***

Washing fastness of the untreated samples was done according to ISO 105-C01: 1998(E). Two single fiber adjacent fabrics complying with the relevant sections of F01 to F08 of ISO 105-F: 1989. One adjacent fabric of cotton and the second of wool.

***(b) Perespiration fastness (PF)***

*Fastness to synthetic perspiration was measured according to ISO-E04: 1994.*

***(c) Light fastness (LF)***

*Fastness to light was measured according to ISO 105:1997 using standard wool blue scale as a reference in all tests. The grads used throughout this research were (1 is not fast and 5 is greatly fast to light).*

***Determination of acid value***

Determination of COOH group content and ester value of the treated samples was carried out applying the method described by (Ghosh *et al.* 1995). The cotton samples were made anion free by dipping in dilute HCl for 2 hr, and subsequently made HCl free by washing with distilled water prior to acid value determination. FTIR of both unmodified and modified cotton fabrics were obtained using following KBr-wafer technique as detailed elsewhere (Pancholi *et al.* 1998). The treated fabrics were

crushed to a size finer than 20 meshes before palletizing with KBr which contain 1% powdered fabric.

#### **Determination of weight gain**

Moisture regain of the untreated and treated cotton fabrics was determined using the standard method according to (ASTM, 1974). For the determination of the weight gain the samples were washed with soap and then washed in a water bath several times with water and methanol-water mixture in order to insure removal of traces of AA that remains unbound with the cotton fabrics. The washed samples were then oven dried to a constant weight ( $W_1$ ) at 100°C. The weight gain (%) was then calculated on the basis of initial dry weight of untreated samples ( $W_2$ ) using the relationship:

$$\text{Weight gain} = [(W_1 - W_2) / W_2] \times 100$$

#### **Determination of UPF (Ultraviolet protection factor) value**

UPF is the scientific term used to indicate the amount of UV protection provided to skin by fabric. UPF is defined as the ratio of the average effective irradiance calculated for skin to the average UV irradiance calculated for skin protected by the test fabric. UPF is defined as the ratio of ED and ED<sub>m</sub> and calculated as follows:

$$\text{UPF} = \frac{\text{ED}}{\text{ED}_m} = \frac{\sum_{290\text{nm}}^{400\text{nm}} E_{\lambda} S_{\lambda} \Delta_{\lambda}}{\sum_{290\text{nm}}^{400\text{nm}} E_{\lambda} S_{\lambda} T_{\lambda} \Delta_{\lambda}}$$

Where:

$E_{\lambda}$  = erythermal spectral effectiveness

$S_{\lambda}$  = solar spectral irradiance in  $\text{Wm}^{-2}\text{nm}^{-1}$

$T_{\lambda}$  = spectral transmittance of the fabric

$\Delta_{\lambda}$  = the bandwidth in nm

$\lambda$  = the wavelength in nm

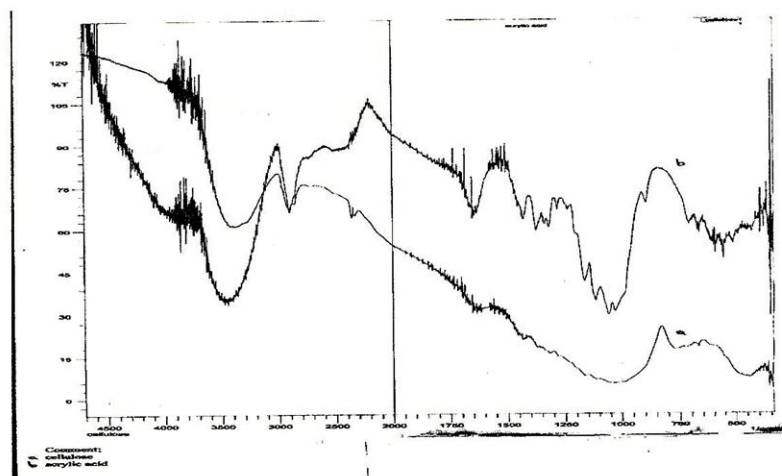
ED = a dose for unprotected skin calculated by convolving the incident solar Spectral power as relative spectral effectiveness function and summing over the wavelength of 290-400nm.

UPF's were measured using Perkin-Elme: double beam spectrophotometer of model Lambda 35 according to (AS/NZS 4399, 1996).

## RESULTS AND DISCUSSION

### *Fourier Transform Infrared (FTIR) analysis*

Spectrum a, and b (Figure1), represent the infrared of unmodified and modified cotton fabrics. There is a broad absorption band at 3500-3000  $\text{cm}^{-1}$  characteristic of hydrogen bond O-H stretching vibration is common to all spectra. A characteristic absorption band at  $\approx 1740 \text{ cm}^{-1}$  appeared spectrum of the modified sample characteristic of the carbonyl moiety of the ester group.



### *Effect of pH*

Table 1 shows the effect of pH of the AA finishing formulation on the color strength (K/S), and weight gain of the presoaked Giza 89, and Giza 80 Egyptian cotton fabrics (bleached, scoured, or/and mercerized). Use of acidic (PH 5), leads to notable weight gain loss and decreasing of K/s due to the acid hydrolysis. Under the neutral condition (pH 7), optimum esterification leading to substantial weight gain and K/S value were achieved. Slightly alkaline condition (pH 9), also improve the weight gain and K/S value.

It has been noted that the mercerized cotton fabrics for both Giza 89, and Giza 80 showed improvements in both weight gain and K/S value than that of the bleached samples due to increase the amorphous cellulose leading to optimum esterification. The bleached and mercerized samples for Giza 89 show more improvements than that those of Giza 80. The optimum condition of the esterification

pH was 7, for 40 minutes at room temperature, subsequent drying by heating at 95°C for 5 minutes, followed by curing at 140 °C for 5 minutes.

Table 1. Effect of pH on the AA finished cotton fabrics

C.V	Giza 89				Giza 80			
	B+D		B+ M+ D		B+D		B+ M+ D	
pH	Wt. g. %	K/S	Wt. g. %	K/S	Wt. g. %	K/S	Wt. g. %	K/S
5	52.0	6.44	66.59	8.25	51.75	6.41	72.9	7.95
7	69.12	8.56	75.23	9.32	67.09	8.31	72.24	8.95
9	61.69	7.64	69.12	8.56	59.33	7.35	74.2	8.31

C.V- Cotton Varieties, P.T- Pretreatment Processes, B+D- Bleaching and Dyeing, B+M+D- Bleaching, Mercerization and Dyeing, *Wt .g%- weight gain, and K/S- color strength.*

#### **Effect of batching time**

Table 2 shows the effect of batching time of the AA finishing formulation on the color strength (K/S), and weight gain of the presoaked Giza 89, and Giza 80 Egyptian cotton fabrics (scoured, bleached, or/and mercerized). The optimum condition of the esterification time was 40 minutes. Optimum batching time improved diffusion or penetration of the AA within the interstices of the chain molecules of cotton. There is a notable increase due to prolonged scope for induced graft copolymerization at room temperature. The bleached and mercerized Giza 89, showed improvements than that those of Giza 80. The mechanism of the batching time was described by (Premamoy *et al.* 2000).

Table 2. Effect of batching time on the AA finished cotton fabrics

C.V	Giza 89				Giza 80			
	B+D		B+ M+ D		B+D		B+ M+ D	
Time/ Min.	Wt. g %	K/S	Wt. g %	K/S	Wt. g %	K/S	Wt. g %	K/S
20	62.1	7.69	66.6	8.25	65.16	8.07	65.79	8.15
40	69.12	8.56	75.23	9.32	67.09	8.31	72.24	8.95
60	68.95	8.54	69.12	8.56	67.41	8.35	71.91	8.91

C.V- Cotton Varieties, P.T- Pretreatment Processes, B+D- Bleaching and Dyeing, B+M+D- Bleaching, Mercerization and Dyeing, *Wt.g%- weight gain, and K/S- color strength.*

**Effect of AA finishing on tensile strength and elongation% properties**

Table 3 shows that the tensile strength and elongation% are affected by different factors such as bleaching, mercerization, pH, batching time, and AA. The results obtained revealed that the AA finishing cotton fabrics of both Giza 89, and Giza 80 with the optimum conditions (pH 7, batching time, 40 minutes, drying by heating at 95°C for 5 minutes, and curing at 140 for 5 minutes) showed high improvements of tensile strength, and elongation%. The bleached and mercerized samples show decrease in tensile strength than the untreated samples, while no effect for the elongation% was observed.

Table 3. Tensile strength and elongation% of the AA finished cotton fabrics

Treatment method	Cotton varieties			
	Giza 89		Giza 80	
	T (g/tex)	E %	T (g/tex)	E %
Untreated samples	46	12	86	11
Samples after bleaching	40	15	62	10
Samples after mercerization treatment	42	13	63	9
Samples after treatment with AA at pH 7 for 40 min.	56	24	90	16
Samples after treatment with AA at pH 7 for 20 min.	48	13	69	18
Samples after treatment with AA at pH 5 for 40 min.	50	16	75	12

T, Tensile strength (g/tex), and E%, Elongation% at break

**Effect of AA finishing on fastness properties of the cotton fabrics**

It has been noted from Table 4 that there is no significant difference of the fastness properties for the samples used. The cotton fabrics with the optimum condition of treatment (AA 8%, at pH 7 for 40 min.) has a slightly more stable for its fastness properties more than that the other treatments for both Giza 89, and Giza 80.

**Effect of application of  $K_2Cr_2O_7$  and (tetra methyl ammonium chloride) on the UVF of AA finished cotton fabrics**

$K_2Cr_2O_7$  acts as UV absorbers and tetra methyl ammonium chloride as antioxidant were used in this study. The results listed in table 5 showed that there are a significant improvement of UVF of the cotton samples than the untreated samples by the addition of  $K_2Cr_2O_7$  or tetra methyl ammonium chloride. It has been noted that both K/S and fastness properties decreased in the presence of such UV absorbers. This effect may be due to the competition between AA, and UV absorber to bind with the cotton molecules which decrease the diffusion or penetration of the AA within the interstices of the chain molecules of cotton, and therefore, leads to a decrease in the esterification value.



Table 5. Effect of UV agents on the properties of the treated cotton fabrics

Measurements		C	I	II	C	I	II	
		Giza 89			Giza 80			
W.F	gray	4	4	4	4	4	4	
	stain	4	3/4	3	4	3/4	3	
P.F	acid	gray	4	4	4	4	4	
		stain	4	3/4	4	4	3/4	3
	Alkaline	gray	4	4	4	4	4	4
		stain	4	3/4	4	4	3/4	3
Ab.F	Dry	4	4	4	4	4	4	
	Wet	4	3/4	4/3	4	3/4	3/4	
Tensile strength		56	43	42	90	65	68	
Elongation%		24	15	16	16	10	9	
K/S		8.56	7.13	5.13	8.31	7.13	6.01	
UVF		16	29.5	39.8	15.4	27	38.4	

*O.C*- optimum condition of treatment (AA 8%, at pH7 for 40 minutes), C- Control, I  $K_2Cr_2O_7$ , and II tetra methyl ammonium chloride, W.F- washing fastness, P.F- perspiration fastness, and Ab. F- abrasion factor

### CONCLUSION

The appropriate AA finishing of cotton under the neutral condition pH = 7 establishes a convenient route for achieving simultaneous core and surface modification with high scope for incorporating of much improved physical and mechanical properties for the Egyptian Giza 89 and Giza 80 cotton fabrics.

The major improvements that can be derived from AA finishes by following a pad-dry-cure technique under the dual catalyst influence of  $NaH_2PO_4$ , and  $K_2S_2O_8$  are: weight gain or tex value, appearance, basic dye uptake, high fastness properties, high tensile strength and elongation%. The addition of both  $K_2Cr_2O_7$ , or tetra methyl ammonium chloride improves the UV-protection value. It has been noted that the improvement of some properties for mercerized Egyptian cotton fabric Giza 89 using the above reagents and conditions was more pronounced than that observed for Giza 80.

Table 4. Effect of AA finishing on fastness properties of the cotton fabrics

Treatment method	Cotton varieties											
	Giza 89						Giza 80					
	W.F.		Ab. F.		P.F.		W.F.		Ab. F.		P.F.	
gray	stain	Dry	wet	acid	alkalin	gray	stain	gray	stain	acid	alkalin	
Untreated	-	-	-	-	-	-	-	-	-	-	-	-
After bleaching	4	3	4	4	4	3	4	3	4	3	4	3
After mercerization	4	3/4	4	3/4	4	3/4	4	3/4	4	3/4	4	3/4
AA at pH 7 for 40 min.	4	4	4	4	4	4	4	4	4	4	4	4
AA at pH 7 for 20 min.	4	3/4	4	4	4	3/4	4	3/4	4	3/4	4	3/4
AA at pH 5 for 40 min.	4	3/4	4	4	4	4	4	4	4	4	4	4

W.F = Washing fastness, Ab.F = Abrasion factor, P.F = Perspiration fastness, Gr=Gray and St. =Stain

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## تحسين خواص بعض الأقمشة القطنية المصرية ببعض المعالجات الكيميائية.

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أصبحت عمليات التجهيز النهائي للأقمشة القطنية المصرية من العمليات الصناعية الهامة لإعطاء المنتج النسجي صفات ذات جودة معينة.

الهدف الأساسي من البحث هو تحسين خواص الأقمشة المصرية بعد المعالجات الرطبة (تبييض أو تبييض مع المرسة) من صنفى جيزة ٨٩ و جيزة ٨٠ باستخدام حمض الأكرليك كمادة تجهيز نهائي و باستخدام كل من ملح ثنائي كبريتات البوتاسيوم و ملح ثنائي الهيدروفوسفات كعوامل حفازة ثم صباغة الأقمشة القطنية المستخدمة بالصبغة النشطة مع إضافة تركيزات محددة من كل من ملح رباعي المثلل كلوريد الأمونيوم أو ملح ثنائي كرومات البوتاسيوم كمواد مضادة للأشعة فوق البنفسجية.

تم في هذا البحث:

- \* معالجة الأقمشة القطنية من صنفى جيزة ٨٩ و جيزة ٨٠ و التي تم الحصول عليها كخام من شركة النصر للعزل و النسيج- المحلة الكبرى بعد عمليات التبييض و المرسة.
- \* معالجة الأقمشة القطنية و ذلك بغمر العينات المستخدمة من صنفى جيزة ٨٩ و جيزة ٨٠ بتركيز ٨% من حمض الأكرليك في حوض التفاعل و في وجود العوامل الحفازة في درجة حرارة الغرفة و في أزمنة مختلفة و أس هيدروجيني مختلف ويتم تجفيف العينات ثم تتم عملية التحميص في درجة حرارة ١٤٠ لمدة ثلاثة دقائق.
- \* بعد عملية التحميص تم صباغة العينات المستخدمة بالصبغة النشطة في حوض الصباغة مع إضافة كل من ملح رباعي المثلل كلوريد الأمونيوم أو ملح ثنائي كرومات البوتاسيوم كمواد مضادة للأشعة فوق البنفسجية في نفس الحوض.
- \* تم قياس صفات المتانة و الاستطالة و الوزن المكتسب و درجة الأستره كذلك درجة عمق اللون و ثبات الألوان بالنسبة للضوء و العرق (حامضي أو قاعدي) و الفسيل و أيضا درجة الامتصاص للأشعة فوق البنفسجية

و قد تم التوصل إلي النتائج الآتية:

- ١- استجابة الأقمشة المستخدمة للصباغة زادت نتيجة عمليات المرسة قبل عملية التجهيز النهائي بحمض الأكرليك ووجد أن صنف جيزة ٨٩ أكبر في الاستجابة من صنف جيزة ٨٠.

- ٢- وجد أن درجة الأس الحامضي والوقت في درجة حرارة الغرفة لهم دور هام جدا في عملية التجهيز النهائي بحمض الأكريليك و بالتالي في خواص الأقمشة المستخدمة و قد وجد أن درجة الأس الهيدروجيني = ٧ في أربعون دقيقة هي الأنسب في عمليات التجهيز النهائي للعينات.
- ٣- بمقارنة كل من العينات الغير معالجة والمعالجة بحمض الأكريليك للأقمشة المستخدمة و ذلك عن طريق تحديد المجموعات الكيميائية باستخدام جهاز الأشعة تحت الحمراء أن العينات المعالجة قد اكتسبت الوزن - زيادة المتانة- الاستطالة- زيادة الاستجابة للصبغة- القدرة العالية علي الثبات للغسيل- للعرق و أيضا للضوء.
- ٤- جميع الخواص قد ازدادت للعينات التي تم معالجتها عن العينات الغير معالجة و صنف جيزة ٨٩ أكبر في الاستجابة من صنف جيزة ٨٠.
- ٥- وجد أن العينات المعالجة بأملح الأمين أو ثنائي كبريتات البوتاسيوم لها قدرة ممتازة علي امتصاص الأشعة فوق البنفسجية و ذلك لحماية الجلد من الإصابة بسرطان الجلد عن العينات الغير معالجة و صنف جيزة ٨٩ أكبر في الاستجابة من صنف جيزة ٨٠.
- ٦- وجد أن الاستجابة للصبغة اعلي للعينات المصبوغة بعد المعالجة بحمض الأكريليك و بدون إضافة الأملاح المضادة للأشعة فوق البنفسجية في حوض الصباغة وكنتيجة نهائية:-
- ١- فأن استخدام حمض الأكريليك كمادة تجهيز نهائي تعمل علي تحسين خواص الأقمشة القطنية بزيادة درجة عمق الصبغة و أيضا زيادة ثبات اللون- اكتساب الوزن- زيادة المتانة- الاستطالة- القدرة العالية علي الثبات للغسيل- للعرق و أيضا للضوء.
- ٢- توفير ملايين من الجنيهات لمصانع الغزل و النسيج و ذلك بتوفير كميات كبيرة من الصبغات و الكيماويات و الوقت و الزمن أثناء هذه العمليات.
- ٣- استخدام كل من أملاح الأمين أو ثنائي كبريتات البوتاسيوم تعمل علي زيادة قدرة الأقمشة المعالجة علي مقاومة الأشعة فوق البنفسجية و بذلك ينصح باستخدام هذه الأقمشة المعالجة في ملابس العاملين الذين يتعرضون لأخطار التعرض لهذه الأشعة.