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# NEW TREATMENT TECHNIQUE OF SOME TREATED COTTON FABRICS FOR PROTECTION FROM POLLUTANTS IN EGYPT

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## ABSTRACT

This paper includes a study on the effect of different environmental conditions on the physical, chemical, and mechanical properties of some dyed textiles made of some Egyptian cotton treated with acrylic acid and finished with (4-methoxybenzylidene)-(3-methoxyphenyl)-amine).The samples under test were subjected to weathering effects at industrial site in Egypt. Two groups of each fabric were used, the first group was exposed monthly to the prevailing conditions starting on August (2007) till July (2008) while the second one was exposed continuously for one year. The tensile strength (Kg), and the elongation% were measured for the untreated and treated samples. The color measurement such as color strength (K/S) and ultraviolet radiation were evaluated in terms of ultraviolet protection factor value (UPF) was also tested. The results obtained revealed that the effect of climatic conditions at this sector of Cairo area: 6$^{th}$ of October city on the degradation of the treated and untreated cotton fabrics are:

a) The maximum degradation was observed after eight months resulting in deterioration in tensile strength, elongation and K/S values.

b) The treated samples show an excellent resistance for tensile strength, elongation, K/S,

and UPF than the untreated samples

c) Giza 89 treated cotton fabric shows an excellent results compared with Giza 80 cotton fabrics

**Keyword:** Egyptian cotton, color strength, environmental conditions

# INTRODUCTION

The fact that humans, who are responsible for the misuse and destruction of natural sources are the party suffering the greatest harm within the ecosystem has increases the importance of environmental responsibility even more. In environmental-based protection strategies, environmental protection has become an economic activity that needs to be taken into consideration through all processes from designing to packaging. The textile industry is among the largest industries in the world with regard to production and labor. It exhibits a typical variation in scale: e.g from large scale machinated to small scale traditional unit. Broadly, this industry is classified to cotton, woolen, and synthetic fiber industries. Parameters responsible for environmental pollution include chemicals discharged to air, water and soil as well as energy pollution, (Nemli,E. 2001). The textile industry is characterized not only by the vast quantity of water required, but also by the variety of chemicals used. The deterioration of textiles is largely chemical in nature and also, by air pollution problems such as smoke and odor arising in the processes. Both natural and artificial light sources can cause photochemical degradation. The exposure of fabrics to heat, higher temperatures accelerate the rate of chemical reactions, speeding up the degradation of mechanical properties and fabric dye ability. Egyptian cotton has international known reputation of special features that attract niche market consumers. Under many environmental conditions the exports of Egyptian raw cotton and cottoned textiles decreased, this would result in social and economical problems, (Ziad A, and Khaled W. 2002). Moustafa et al. (2006) investigated the effect of environmental conditions on the cotton fabric in Egypt.

The effect of temperature and relative humidity on the photo-degradation of fibers has been studied by Tera et al. (1981). It was recommended that both are best studied together, because a change in temperature, almost invariably causes a change in moisture content during exposure time the temperature and moisture content of the samples will therefore vary continuously throughout the exposure period. Nadia et al. (2003) described the effects of air pollution on textiles exposed to Cairo's ambient atmosphere

Tennent (2008) reported that air pollutants affect dyed and undyed textiles by causing them to fade, discolor and undergo chemical degradation.

Zeronian (1970) carried out laboratory exposures in which he exposed cotton and rayon fabrics for 7 days to clean air with and without 250 ug/m' (0.1 ppm) sulfur dioxide. Loss in strength for all fabrics exposed to clean air averaged 13%, while the fabrics exposed to air containing sulfur dioxide averaged 21%.

Yatagai and Zeronian (1994) studied the changes in properties of cellulose brought about by ultraviolet (UV) irradiation, heat exposure and by a combination of both treatments. The methods of characterizing the changes included breaking strength, color, yellowness index, thermal analysis, dye adsorption as a measure of changes in fine structure of the fibers, and Turnbull's Blue test as an empirical measure of carboxyl content.

UV absorber agents are organic or inorganic colorless compounds with strong absorption in the UV range of 290 – 360 nm, Perenich (1998). UV absorbers incorporated into the fibers convert electronic excitation energy into thermal energy, function as radical scavengers and singlet oxygen quenchers. The high-energy, short-wave UVR excites the UV absorber to a higher energy state; the energy absorbed may then be dissipated as longer-wave radiation. Isomerisation can occur and the UV absorber may then fragment into non-absorbing isomers. Inorganic UV blockers are more preferable to organic UV blockers as they are non-toxic and chemically stable under exposure to both high temperatures and UV. This is due to the fact that nano-particles have a larger surface area per unit mass and volume than the conventional materials, leading to the increase of the effectiveness of blocking UV radiation.

Various researches work deal with the application of UV-blocking treatment to fabric using nanotechnology. UV-blocking treatment for cotton fabrics was developed using the sol-gel method. A thin layer of titanium dioxide is formed on the surface of the treated cotton fabric which provides excellent UV-protection; the effect can be maintained after 50 home launderings.

A typical cotton fabric could transmit 15-20% UVR, rising to more than 50% if the garment is wet. For adequate protection, the UVR transmission should be lower than 6% and 2.5% for extremely good protection, (Menter and Hatch 2003). Depending upon the type of dye or pigment, the absorptive groups present in the dyestuff, depth after dyeing, the uniformity and additives, the UV protection abilities of the textile materials are considerably influenced, (Algaba et al. 2004).

Saleh et al. (2007) studied the improvement of some properties for both Bleached or/and mercerized Egyptian Giza 89, and Giza 80 cotton fabrics. The results obtained revealed that the major property advantages of the cotton fabric were: weight gain, basic dye uptake (K/S) value, high fastness properties, high tensile and elongation, and high UV-protection value. It has been noted that the mercerized Giza 89 shows good properties than the other treated samples. Dyeing characteristics and UV protection property of green tea dyed cotton fabrics was described by Sin Hee-Kim. (2006). An evaluation of UV protection imparted by cotton fabrics dyed with natural colorants was demonstrated by Sarkar and Seal. (2004). The fluorescence of sun-protected white cotton fabrics using 3-chloro-2-hydroxy-propyl-trimethyl-ammonium chloride (CHPTAC) was carried out during mercerization, Ana et al. (2004). Raw and pretreated cotton knit samples were treated with the optical brightener Uvitex BHT (Ciba) in a wide concentration range (0.06% – 6%) and treated with 0.5% of UV absorber Tinofast CEL (Ciba). The weather conditions in Egypt are different from one zone to another according to its geographical site and environmental conditions available there. For example, the weather in $6^{th}$ of October city as industrial is hotter and sunnier than that the residential areas, beside the factories in $6^{th}$ of October city have a lot of effluents which pollute the environment there. For these reasons, this work studied the effect of different environmental conditions on the physical, chemical, and mechanical properties of some textiles made of Egyptian cotton treated with acrylic acid and finished with potassium (4-methoxybenzylidene)-(3-methoxyphenyl)-amine).

# MATERIALS AND METHODS

## Materials

Unbleached weave of Egyptian cotton fabrics namely Giza 89, and Giza 80 purchased from El-Nasr for spinning and textile Company– El-Mehalla, Egypt were used for the present study. All chemicals used were of analytical grade using doubly distilled water

(18.5 MΩ.cm$^{-1}$). NaOH was analytical grade (Koch-Light Co.). Hydrogen peroxide (30%. LR grade) from Aldrich. Sodium carbonate (LR grade), sodium silicate (136°Tw, 27% $SiO_2$), the wetting agent was the commercially Mercerol supplied by Merck. The hydrogen peroxide bleach liquor for each bleaching process was analyzed by titration with potassium permanganate.

**Scouring, bleaching mercerizing, dyeing and finishing 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 an anionic detergent 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 was immersed in an alkaline bleach liquor(180 ml deionized water) containing sodium carbonate (0.2 gl$^{-1}$), sodium hydroxide (1.5 gl$^{-1}$), sodium silicate (0.4 gl$^{-1}$), magnesium sulphate (0.2 gl$^{-1}$), wetting agent (0.5 gl$^{-1}$) and hydrogen peroxide (10 ml$^{-1}$) was added to the bleach liquor and bleaching was done. 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.1% acetic acid and then washed thoroughly with hot water (80-85°C) to ensure removal of residual chemicals. Samples were dried in an oven at 100°C for 60 minutes.

Application of acrylic acid on the cotton fabric, followed by dyeing the samples in solutions of Procion Crimson CX-B. The dyeing was carried out at a liquor ratio of 1:20, in a sealed stainless steel dye bath. The temperature and duration of dyeing were 80°C and 45 min. respectively. After dyeing, the dyed samples were taken out and rinsed thoroughly in tap water, and dried freely in open air, then subjected to soaping off in a boiled solution containing 5 g/l non-ionic surfactant for 15 min. at the liquor ratio of 1: 50. The soaped-off dyed samples was then rinsed in tap water and dried freely in open air. The addition of known concentration of (4-methoxy-benzylidene)-(3-methoxyphenyl)-amine) as UV protective agents were carried out according to our previous work, Saleh et al. (2007).

### Samples exposure

The samples under test were subjected to weathering effects at industrial site in Egypt. Thus, outdoor unprotected exposure for of all the examined samples was performed at 6th of October city as industrial area.

Two groups of each fabric were used, the first group was exposed monthly to the prevailing conditions starting on August (2007) till July (2008) while the second one was exposed continuously for one year.

## Methods

### Measurements of dye ability

The color strength expressed as (K/S) was measured using Perkin-Elmer double beam spectrophotometer of model Lambda 35 that is equipped with integrating sphere according to the Kubelka-Munk that given by:

$$K/S = (1-R)^2/2R - (1-R0)^2/2R0$$

Where *R* is the reflectance of the colored fabric, *R0* is the reflectance of the uncolored fabric, and K/S is the ratio of the absorption coefficient (*K*) to scattering coefficient (*S*): the higher the value, the greater the color strength.

### Measurements of ultra factor protection value (UPF)

UPF is the scientific term used to indicate the amount of UV protection provided to skin by fabric calculated according to AATCC Test method 183: Transmission or Blocking of Erythermally Weighted Ultraviolet Radiation through Fabrics (AATCC, 2002). Measurements were performed using a Perkin -Elmer double beam spectrophotometer of model Lambda 35 with an integrated sphere attachment and a Schott glass UG-11 filter. UPF was calculated using mean percentage transmission in the UVA region (320-400) and mean percentage transmission in the UVB region (280-320) according to the following equation:

$$UPF_t = \frac{\sum_{\lambda=280}^{400} E_\lambda * S_\lambda * \Delta_\lambda}{\sum_{\lambda=280}^{400} E_\lambda * S_\lambda * T_\lambda * \Delta_\lambda}$$

Where:

$E_\lambda$ = erythermal spectral effectiveness

$S_\lambda$ = solar spectral irrediancein $Wm^{-2}nm^{-1}$

$T_\lambda$ = spectral transmittance of the fabric

$\Delta_\lambda$ = the bandwidth in nm

$\lambda$ = the wavelength in nm

Ultraviolet radiation up to 60 times as strong as the sun's rays was directed through the fabric and onto the skin for varying periods of time. The resulting degree of sunburn to the exposed skin determined the fabric's Protection Factor.

**Tensile properties**

The tensile strength (Kg) and elongation (%) were measured according to ASTM D 412-98a using Zwick testing machine of model Z010 and equipped with 10Kn load cell and the testing was conducted at speed of 100 mm/min. The results obtained were based on an average of ten tests in the wrap direction of each sample.

# RESULTS AND DISCUSSION

**Climatic conditions**

The climatic conditions data were recorded continuously at the nearest meteorological station to the exposure site by the aid of the "Egyptian Meteorological Association". The mean values of twenty four hours readings of temperature of the surroundings, relative humidity, incident solar energy and total sum hours were evaluated and given in tables (1).

### Monthly total incident sun hours and ultraviolet radiation

The monthly values of the total incident sun hours falling on the earth surface which were recorded at the nearest meteorological station to 6th of October City area was shown in both table (1). A maximum was observed in July and a minimum in January. The cyclic seasonal variation of the UV radiation J/Sq m was observed, in which a maximum value was shown in July and a minimum in January.

### Means of maximum temperatures and relative humidity of the surroundings

A maximum mean temperature was observed in July and a minimum in January. A maximum means of relative humidity was observed in August, September and January and a minimum in May.

**Table 1. Monthly data of climatic conditions in 6th of October city (Year: 2007/2008).**

| Exposure time in months | UV (J/Sq m) | Total sun hours/month | Temp $^0$C mean of maximum | Relative humidity % maximum |
|---|---|---|---|---|
| **August** | 881 | 360.1 | 41.2 | 87 |
| **September** | 743 | 320.0 | 40.8 | 87 |
| **October** | 570 | 319.2 | 40.5 | 84 |
| **November** | 422 | 275.4 | 35.6 | 80 |
| **December** | 344 | 261.3 | 30.1 | 85 |
| **January** | 320 | 250.9 | 28.1 | 87 |
| **February** | 420 | 272.6 | 29.2 | 81 |
| **March** | 665 | 271.6 | 35.7 | 80 |
| **April** | 803 | 316.1 | 41.0 | 71 |
| **May** | 875 | 352.3 | 44.2 | 75 |
| **June** | 940 | 362.2 | 45.1 | 77 |
| **July** | 952 | 370.0 | 45.6 | 85 |

## Mechanical and physical properties

### Effects of the exposure time in months on the tensile strength and elongation of the treated and untreated cotton at 6th of October City.

The changes in the mechanical properties of the exposed samples to the environmental conditions at 6th of October city are shown in Figure1 and Figure 2 respectively. It was shown that the level of degradation of all the examined fabrics varied cyclically with the season of the year.

The monthly exposed samples showed maximum deterioration of tensile strength in August from (63 to 39 Kg) and a minimum in January and February (63 to 48 Kg) for control (scoured, bleached, mercerized, and finished with AA without the addition of (4-methoxybenzylidene)-(3-methoxyphenyl)-amine) as UV protective agents and from (88 to 69 Kg) in August and (88 to 80 Kg) for the treated cotton fabrics (the above mentioned with the addition of the UV absorber) of Giza 80 and from (42 to 26 Kg) in August and minimum in January (54 to 46 Kg) for the control of Giza 89 and (54 to 51 Kg) for the treated samples in February. For the next four monthly removed samples, the deterioration of tensile strength was increased progressively at a rapid rate with increased exposure to environmentally conditions to be 63 and 27 for the treated and untreated cotton fabric samples for Giza 80 and 42 and 19 for Giza 89 respectively. After eight months removed samples, the deterioration of the tensile strength was in the order 58, 17 and 33 and 12 for Giza 80 Giza 89 respectively. After 12 months of exposure the deterioration of the tensile strength was observed but in a slower rate. It has been observed that the deterioration of the tensile strength 56 and 12 for Giza 80 and 31 and 9 for Giza 89 respectively. These results are in agreement with our previous work, which showed that the tensile strength of the cotton fabrics increased due to the mechanism of modification of cotton with acrylic acid under the influence of $NaH_2PO_4$ used as esterification catalyst and $K_2S_2O_8$ used as the catalyst involves free-radical polymerization and graft co-polymerization of acrylic acid on cotton. This modification leads to notable weight gain and changes in the chemical nature of cotton during the overall process. However, the acrylic acid ester of cotton may then react with the excess acrylic acid leading to thermal polymerization of the monomeric acid and to subsequent crosslinking of cotton during the drying and curing step. The addition of (4-methoxybenzylidene)-(3-methoxyphenyl)-amine) increased the tensile strength which was act as a synergetic effect.

The monthly exposed samples showed maximum deterioration of elongation% in August from (9 to 6%) and there was no significant deterioration in January and February for the control and treated cotton fabrics of Giza 80, and from (13 to 11%) in August and (25 to

24%) in February for the control and treated cotton fabrics of Giza 89. For the next four monthly removed samples, the environmentally conditions on the deterioration of elongation% had no significant effect and the elongation% remained in the same range for the control of Giza 80. The deterioration of elongation% was in the range of 18 to 12% for the treated samples. The deterioration of tensile strength was increased progressively at a rapid rate with increased exposure to environmental conditions for both control and treated cotton fabrics of Giza 89 to 9 and 15% respectively. After eight months removed samples, the deterioration of the tensile strength was in the order 3, and 10% and 7 and 14% for Giza 80 Giza 89 respectively. After 12 months of exposure the deterioration of the tensile strength was observed but in a slower rate. It has been observed that the deterioration of the tensile strength 562 and 9% for Giza 80 and 3 and 13% for Giza 89 respectively.

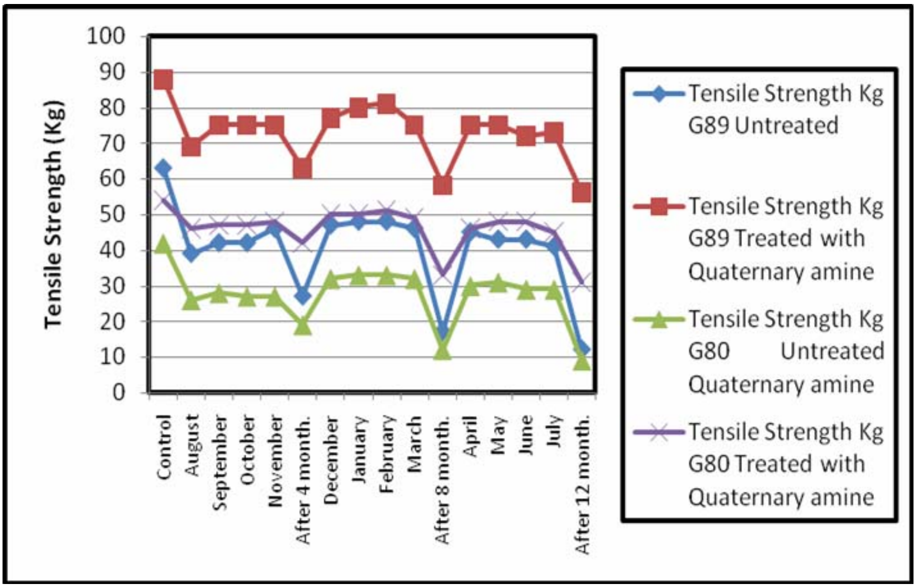


**Figure 1. Monthly measurement of tensile strength (kg) of cotton fabrics at 6th of October city (2007/2008)**

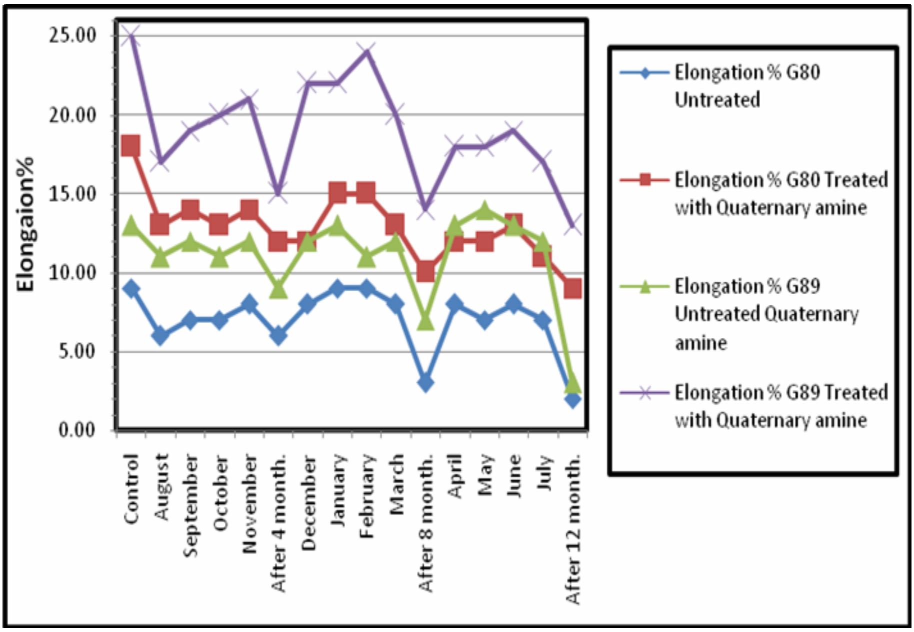


**Figure 2. Monthly measurement of Elongation (%) of cotton fabric at 6th of October city (2007/2008)**

## Effects of the exposure time in months on color strength of the treated and untreated cotton

The monthly exposed samples showed very slowly deterioration of color strength (K/S) during the yearly exposure time for both treated and untreated cotton fabrics as shown in Figure3. It has been noted that the addition of (4-methoxy-benzylidene) – (3-methoxyphenyl) - amine) decrease the color strength (K/S) compared with the control samples. This effect may be due to the competition between AA, and UV absorber to bind with the cotton molecules. This leads to a decrease in the diffusion or penetration of the AA within the interstices of the chain molecules of cotton, and therefore the esterification value might decrease. In general, the cotton samples did not exhibit significantly different amounts of color changes during the seasonally exposure time.

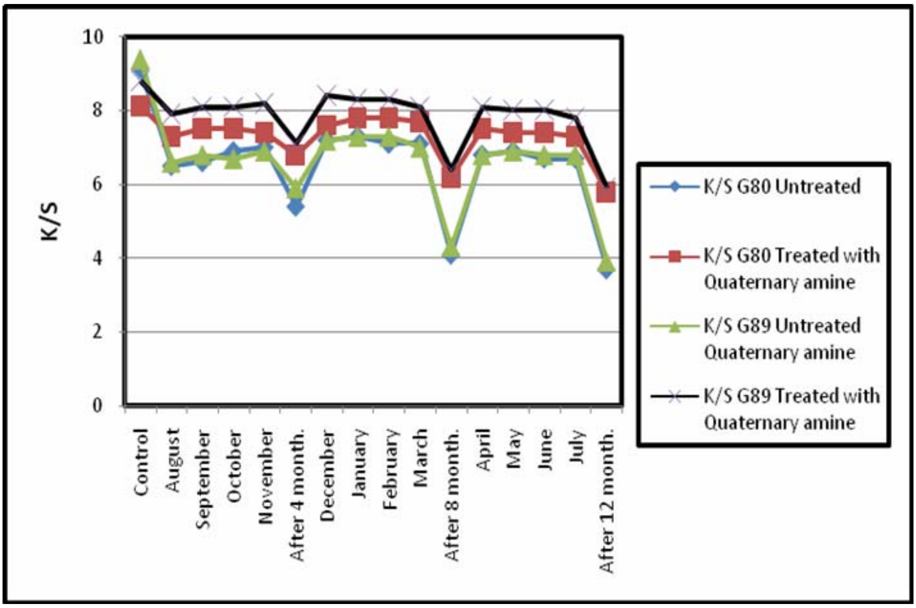


**Figure 3. Monthly measurement of K/S for cotton fabrics at 6$^{th}$ of October city (2007/2008)**

**Effect of the exposure time in months on UPF of the treated and untreated cotton.**

The results in Figure 4 show that the addition of (4-methoxybenzylidene) - (3-methoxyphenyl)-amine) maximized the UV protection of both Giza 80 and Giza 89 compared with the control samples. The organic chemical absorbers have reactive structures that can take up the energy from UVR and then go back to a relaxed state by sending out the energy as heat. The physical absorption process of quaternary amine protects both the dye and the fabric from the high-energy fractions of sunlight. These are absorbed and lead to isomerization, causing the molecule to transform into an excited structure. When the molecule reverts to its original condition, the absorber releases the energy into the environment as a thermal energy. The UV absorption mechanism of (4-methoxy-benzylidene) - (3-methoxyphenyl) - amine) may be due to combining with oxygen when exposed to light to form stable nitroxide radicals. The latter trap the radicals, which have developed from the polymer through exposure to UV rays. The most important feature of the nitroxide radicals is their regeneration capacity. Thus, a chain reaction is possible, which can repeat hundreds of times until the (4-methoxy-benzylidene) - (3-methoxyphenyl)- amine) has been degraded. Radical chain reactions which attack the fabric samples were thus prevented. It has been noted that the (4-methoxybenzylidene) - (3-methoxyphenyl) - amine) effectiveness depend on optimum dispersal in the binding agent. The values of UPF showed that the treated cotton fabrics had a great resistance for environmental conditions during the seasonal year exposure time. There were no significant difference values for the monthly or the yearly exposed samples.

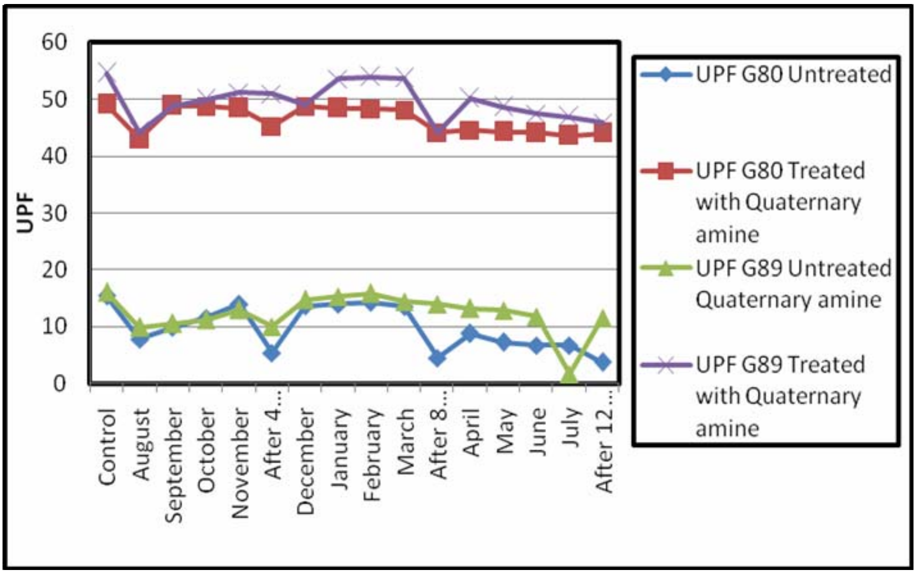


**Figure 4. Monthly measurement of UPF at 6th of October city (2007/2008).**

## Conclusion

This paper studied the effect of different environmental conditions on the physical, chemical, and mechanical properties of some textiles made of some Egyptian cotton treated with acrylic acid and finished with (4-methoxy-benzylidene) – (3-methoxyphenyl) – amine). The samples under test were subjected to weathering effects at industrial site in Egypt. Two groups of each fabric were used, the first group was exposed monthly to the prevailing conditions starting on

August (2007) till July (2008) while the second one was exposed continuously for one year. The tensile strength (Kg), and the elongation% was studied for the untreated and treated samples. The color measurement such as color strength (K/S) and ultraviolet radiation was evaluated in terms of ultraviolet protection factor value (UPF). The results obtained reveal that the effect of climatic conditions at this sector of Cairo area: 6th October city on the degradation of the treated and untreated cotton fabrics are as follows:

a) The treated samples with AA showed a resistance effect for tensile strength degradation among the untreated samples.

b) The maximum degradation was observed after eight months resulting in deterioration in tensile strength, elongation and K/S values.

c) The treated samples with 4-methoxy-benzylidene)-(3-methoxyphenyl)-amine) showed an UPF excellent resistance among the untreated samples.

d) Giza89 treated cotton fabric shows an excellent results compared with Giza 80 cotton fabrics.

e) In general, all the mercerized samples of both Giza 89 and Giza 80 showed an excellent protection to weathering effects at industrial site in 6th of October city Egypt.

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# تقنية جديدة لحماية بعض الأقطان المعالجة من التلوث البيئي في مصر

**صلاح منصور صالح[1]، عبد الرحم رمضان[2] و أحمد بهاء مصطفي[2]**

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يعد التلوث مشكلة استراتيجية تواجه المجتمع المصري، فقد جاء في تقرير منظمة الصحة العالمية أن نسبة التلوث في مصر تزيد علي ثلاثة أمثال المعدلات العالمية للتلوث و تتفاقم هذه النسبة في محافظات القاهرة الكبري ( القاهرة- الجيزة- القليوبية- 6 أكتوبر) عن سواها من محافظات الجمهورية. هذه النسبة العالية من التلوث نتجة للأنبعاثات الناتجة من عوادم السيارات، فضلا عن انتشار المصانع وخاصة في القليوبية- 6 أكتوبر و حلوان و منها تنبعث عناصر و غازات ضارة بالبيئة مثل أول و ثاتي اكاسيد الكربون و الكبريت و النتيروجين و التي تسبب الأمطار الحمضية و التي تؤثر تأثير سلبي علي المنتج النسجي و تساعد عي زيادة تدهور هذه الأنسجة و التناقص في العمر الأفتراضي لهذا المنتج، هذا بالإضافة الي التعرض لأشعة الشمس و ما كميات الأشعة فوق البنفسجية الصادرة مما يؤدي الي التأثير السلبي علي صباغة هذه المنسوجات.

يهدف هذا البحث الي معالجة بعض الأقطان و تجهيزها لمقاومة العوامل المناخية في مدينة السادس من أكتوبر (المنطقة الصناعية) بهدف المحافظة علي متانة الأقمشة و عدم تعرضها للتلف السريع و العمل علي ثبات الصباغة بهدف المحافظة علي المظهر الجمالي للمنتج النسجي مما يؤدي الي خفض التكلفة الأقتصادية للفرد باطالة العمر الأفتراضي للمنتج النسجي و كذلك مقاومة الأشعة فوق البنفسجية للحفاظ علي صحة الأنسان .

تم في هذا البحث معالجة الأقمشة القطنية المصنوعة من صنفي جيزة 89 و جيزة 80 بعد اجراء المعملات الأولية ( غلي- تبييض- مرسرة) بأستخدام حمض الأكريليك (8%) كمادة تجهيز في وجود مادتي الملح البوتاسي لحمض بيروكسي ثنائي الكبريت و ملح ثنائي الهيدروفوسفات كعوامل حفازة، ثم تم صباغة العينات بالصبغة النشطة Procion Crimoson CX-B مع اضافة تركيز محدد من مادة رباعي ميثوكسي بنزيليدين-3- ميثوكسي فينيل أمين كمادة مضادة للأشعة فوق البنفسجية

تم تعريض هذه العينات للعوامل البيئية و المناخية مثل (درجة الحرارة- نسبة سطوع الشمس- الأمطار الحمضية- الأشعة فوق البنفسجية) لمدة عام كامل بدأ من من شهر أغسطس سنة 2007 الي شهر يولية 2008 و ذلك يوضع مجموعتان من العينات علي لوح خشبي في بزاوية 45° اتجاه الجنوب. تم قياس نسبة المتانة و الأستطالة و درجة عمق اللون K/S و كذلك درجة المقاومة للاشعة فوق البنفسجية UPF و تمت القياسات علي المجموعة الأولي شهريا و المجموعة الثاتية كل اربعة اشهر من التعريض.

و يمكن تلخيص النتائج التي تم التوصل اليها فيما يلي:

1- العينات المعالجة بحمض الأكريليك كانت لها مقاومة عالية جدا لمنع التدهور الحادث عن العينات غير المعالجة نتيجة تكوين الروابط العرضية بين الحمض و سلاسل السليلوز للأقطان.

2- أقصي تهور في المتانة و عمق اللون و الأستطالة حدث بعد مرور ثمانية اشهر من التعريض.

3- أضافة المادة القاومة للأشعة فوق البنفسجية عملت علي تحسين المنتج و مقاومته للاشعة خلال مدة التعريض.

4- الأقمشة المصنوعة من صنف 89 أعطت نتائج افضل من الأقمة من صنف جيزة 80.

5- جميع العينات الممرسرة للصنفين أعطت نتائج أفضل من العينات غير الممرسرة

6- جميع القياسات اثبتت ان العينات المعالجة لها قدرة عالية علي مقاومة التدهور في المتانة بالأضافة الي ثبات لون الصبغة و كذلك القدرة العالية علي مقاومة الأشعة فوق البنفسجية الساقطة عليها.

و كنتيجة نهائية لهذا البحث فأنه امكن المحافظة علي متانة الأقمشة و عدم تعرضها للتدهور و العمل علي ثبات الصبغة و مقاومة الأشعة فوق البنفسجية الساقطة عليها.

و ذلك للحفاظ علي صحة الأنسان و ايضا خفض التكلفة الأقتصادية للفرد باطالة العمر الافتراضي للمنتج النسجي.