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UTILIZATION OF LIGHT MICROSCOPE IN DETECTING DETERIORATION, DEGRADATION, AND QUALITY OF SOME EGYPTIAN COTTONS

الاستفادة من الميكروسكوب الضوئى فى التنبوء بالتلف والتحطم والجودة لبعض الاقطان المصرية بعد تعرضها للضوء الصناعى

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الخلاصة – استخدم الميكروسكوب الضوئى للتعرف على تأثير الضوء على متانة الشد ، ورقم الجودة ونسبة تلف الشعيرات القطنية وثبت أن متانة الشد وكذلك رقم الجودة بتناقصان بزيادة زمن تعريض الشعيرات القطنية للضوء الصناعى ، بينما تزداد نسبة التلف مع زيادة زمن التعريض . وثبت أيضا أن تعرض شعيرات القطن للضوء يحدث فقد فى متانة الشد بمقدار يتراوح ما بين ٢٫٠٢/ الى ٢٫٢٠٪ ،وبمقدار يتراوح بين ٣٫٤٦/ الى ٢٣٫٣٩/ بالنسبة لرقم الجودة بينما تزيد نسبة الشعيرات التالفة بمقدار يتراوح ما بين ٠٫٦٥٪ الى ٣٧٫٦٩٪ . وعلى ذلك فانه من الضرورى اعادة التفكير فى أسلوب تخزين الشعيرات القطنية سواء قبل حلجها وأيضا قبل غزلها للمحافظة على متانة وجودة الاقطان المصرية .

ABSTRACT

The light microscope was used to follow up the behaviour of some Egyptian cottons when subjected to light in the Fade-o-meter Tester.

In this paper the behaviour of Giza 31, Giza 70, and Giza 81 Egyptian cottons, placed in the swelling agent has been examined through the photographs taken by a camera fitted to the used microscope. Attention was paid only towards the primary wall and the secondary wall.

It was found that fibre bundle strength and/or quality number tends to decrease with the increase of exposed time. The higher the quality number, the higher the percentage of undamaged fibres in the sample and vice-versa.

INTRODUCTION

Lots of discussions were made among especialists in the Egyptian Textile Industry, about damage of cotton. Some of them relate the damage to the conditions of processing in the mills, while some relate it to the conditions of storage in the ginning and spinning mills [2].

At present emphasis is placed on finding first the causes of damage, then finding the suitable methods for assessing damage, and finally to find suitable scientific means for protecting this valuable crop from the forces of decomposition.

The damage of cotton starts from the time the boll opens till cotton is converted to textile products. Because of labour proplem, cotton remains in the fields for long periods before harvesting and transfering to the ginning mills. There is no dout that, the over exposure in the field affects some of the properties such as luster, colour and strength of cotton [3, 4, and 5].

Also damage may also arise from drying of cotton over long periods. The fibre becomes brittle by time and will break easily during processing. This in turn will reduce the quality of the fibre.

In addition damage of cotton may arise from the bad storage conditions in the country; at present cotton sacks in the ginning mills and cotton bales in the spinning mills are stored in open areas, with no protection against enviromental conditions. Under these conditions the fibres are subjected to sunlight, wind, dust, rain and heat. The storage period may be months and may reach a year .

Cotton like other cellulosic fibres is susceptible to damage from a widely distributed group of micro or-ganismes [6]. Among these many organisms there are usually present various cellulose-destroying types of both bacteria and fungi [2] . It is believed that the cellulose brokedown by certain enzymes secerted by the organisms .

PURPOSE

The purpose of the present investigation is to investigate the possibility of using the light microscope in predicting the strength, quality, and % damage of cotton fibre, when the fibre is subjected to light in the Fade-o-meter .

EXPERIMENTAL

Materials

Varieties of Egyptian cotton fibres namely Giza 31, Giza 70, and Giza 81 were used. In preparing test specimens for this investigation, the method described in Ref. [7] was used .

Light Treatments

Unless otherwise stated, the cotton fibres are irradiated in the Fade-o-meter at 63 $\pm$ 3 °C and relative humidity 80-85 % [7] for varying time periods. The latter range from 45 to 202 hrs (a lternated exposure) .

Preparation of Swelling Agent [8 and 9]

The swelling agent used consists of $ZnCl_2$ (100 g), KI (32 g), (34 ml) water, and I_2 till saturation.

Microscopic Examination

A light microscope with an attached camera and a heating disc was used. Adjustment of the temperature could be achieved through connection of the disc with Universal Incubator Type U_3 (KOVO) [10].

All the measurements were conducted at constant side temperature of 62 °C.

In microscopic tests the dumbell test desribed in Ref. [1 and 2] was used to assesses damage occured in the fibre. The quality number (Q.N.) was calculated by proportion from the following equation:

$$Q.N.\,\% = \left(\frac{n_1}{n} + \frac{n_2}{2n} + \frac{n_3}{3n} \right) \times 100 \qquad \ldots (1)$$

while the % damaged fibres was calculated from the following equation:

$$\%\,D = \frac{n_3}{n} \times 100 \qquad \ldots (2)$$

where

$$n = n_1 + n_2 + n_3 \qquad \ldots (3)$$

and n_1 = number of undamaged fibres,

n_2 = number of half-damaged fibres,

n_3 = number of damaged of fibres, and

n = total number of examined fibres .

Tensile Strength

The tensile strength was measured using Pressley Strength Tester at zero gauge; i.e. 0.456 in. gripped in the clamps.

The % drop in bundle strength "L %" was calculated from the equation :-

$$L\ \% = \left(1 - \frac{(P.I.)_{ti}}{(P.I.)_{to}} \right) \times 100 \qquad \ldots (4)$$

where $(P.I.)_{ti}$ = fibre bundle strength at treated time,

$(P.I.)_{t_o}$ = fibre bundle strength at room temperature (in our case 25 °C).

RESULTS AND DISCUSSION :

Plotted in Figs. 1 and 2 are the values of Log. P.I. (bundle strength) versus T (exposed time), and the values of the percentage drop in bundle strength with exposed time respectively .

For the above mentioned cottons the general trend obtained is that fibre strength tends to decrease with the increase in exposed time. The decrease or drop in strength (relative to that measured at room temperature) ranges between 2,02% and 20.2% and most considerable at 202 hrs. It is interesting to observe from Fig. 1 that Giza 81 and Giza 70 cottons show higher strength than that obtained for Giza 31. The Giza 31 cotton is the weakest among these cottons either at room temperature and at any of the used times .

When the % drop in bundle strength was plotted versus time (Fig. 2) it was observed that the % drop in strength with exposed time is almost linear, and the correlation coefficient (r) is high (ranging between 0.937 and 0.964) and highly significant at the 5% level. Here again it was found that the strongest cottons, i.e. Giza 81 and Giza 70 showed lesser drop in strength compared with the lesser strength cottons, i.e. Giza 31 .

The drop in strength because of light may be due to the damage of the primary wall and/or to the oxidation of the cellulose. In our case it is propable that the primary wall of Giza 81 and Giza 70 cottons resist the light to a large degree and that the oxidation of the cellulose occurs with rates that are much less than that occuring with Giza 31. In Giza 81 cotton the maximum drop in strength that occured at 202 hrs is not more than 20 % compared with 41.9% and 20.2% for Giza 31 and Giza 70, at the same exposed time .

Plotted in Figs. 3 and 4 are the values of strength (P.I.) versus quality number (Q.N.), and the values of the % drop in quality number versus % drop in strength, respectively. Statistical analysis has shown that tensile strength is positively correlated with the quality number which is basically determined from microscopical examination of fibres. The correlation coefficient (r) is 0.84, 0.93, and 0.97 (for G81. G.70, and G 31), respectivlly.

If was also found that the % drop in quality number is positively corelated to% drop in strength (P.I.) and the correlation coefficient (r) is 0.84, 0.92, and 0.97 i.e. for G.81, G70, and G.31, repectivlly.

The Q.N. ranges between 93.5% for raw ginned cotton and 45.1% for Giza 81 cotton exposed to light for 202 hrs .

Plotted in Fig. 5 are the values of the % of damaged fibres (%D) versus the % decrease in fibre bundle strength. It is observed that generally the % decrease in strength tends to increase with the increase in the % of damaged fibres. This result and the result obtained between strength and Q.N. (Fig. 3) indicated that a relationship would exist between the two microscopical determinations, i.e. the Q.N. and the % D. Plotted in Fig. 6 are the values of Q.N. versus % D for G.81, G70, and G31. It is evident from the plot that generally high values of Q.N. are associated with low values of % damaged fibres and vice-versa. In fact this result pointed to the suitablity of using the % damage as a quick measure for fibre damage, since only one type of fibres (n_3) is counted under the microscope, instead of counting each type n_1, n_2, and n_3. This will save time and effort but the Q.N. has the advantage of considering all fibres in the tested sample, which corresponds to the result obtained for strength, where the everage strength of fibre bundle is recorded.

Mechanism of Photooxidation

Photooxidation results in molecular decomposition of the cellulose, leading to rupture of the ring and the formation of carboxyl groups and finally to the breaking of the -C-O-C- bond in the macromolecular.

The semiquinone structure type of the natural Flarone pigment impurities, play an important role in the formation of peroxide free radical species through oxidation reduction cycle of thses compounds with UV radiation in humid atmosphere.

CONCLUSION

1- For tested Egyptian cotton the strength tends to decrease with the increase in exposed time, and most considerable at 202 hrs. and the least drop in strength occured in the strongest Giza 81 and Giza 70.

2- The quality number (Q.N.) of Giza 81 cotton that has been exposed to light from 45 (hrs) to 202 (hrs) ranges between 86.7 % to 45.1 %. The higher the quality number, the higher the percentage of undamaged fibres in the sample and vice-versa .

3- The drop in strength was associated with a drop in quality number, or with the increase in the number of damaged fibres.

REFERENCES

[1] O'Connor, R.T.,: "Instrumental Analysis of Cotton Cellulose and Modified Cotton Cellulose," Marcel Dekker, INC., New York (1972),

[2] El-Hadidy, A.M. El-Gaiar , M.N, Shahin, A, and El-Hossini,A.: Utilization of light microscope in predicting cotton strength and fibre damage, part I+II. Ms 851072.

[3] Nickerson, D. and Tomaszewski, J.: Sugar, pH, and Strength Changes in Cotton During Storage, T.R.J., Vol. XXVIII,No. 6, June 1958, P. 528-529.

[4] Nickerson, D. and Tomaszewski, J., J.: Color Change in Raw Cotton Related to Conditions of Storage, T.R.J., Vol. XXVIII,June 1958, No. 6, P. 485-497.

[5] Julia, S.L., and Finkner, M.D.: Differences in O utdoor Weathering of Cottons, T.R.J., Vol.38, No. 10, October 1968, P. 1044-1047.

[6] Cooke, T.F.: Resistance to Microbiological Deterioration of Resin-Treated Cellulosic Fabrics, T.R.J., Vol.XXIV ,No.3, March, 1954, P. 197-209.

[7] المواصفات القياسية المصرية رقم ٢٩٧ / ١٩٦٢

[8] Bobeth, W.,: Faserforschung und Textil Technik, Jahrgng 18-Heft 5, Akademie-Verlag, Berlin, 213-222, (1967).

[9] Barghach, A.: Beitrag Zur Qualitasuntersuchung an Baumwollen mittels mikroskopische Quellungs und Losemthoden, Dissertation Tu Dresden, (1964).

[10] El-Hadidy, A.: "Utilization of Microscopic Investigation In Assessment of Changes In Chemical, Mechanical And Physical Properties of Cellelosic Fibres", MSc. thesis, Faculty of Eng., Mansoura University, (1978).

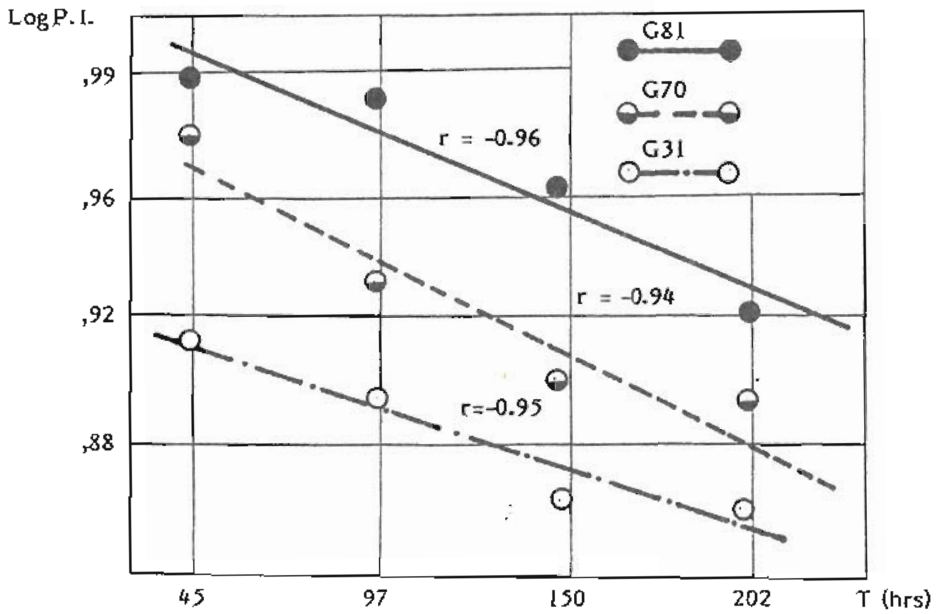

Fig.1: Shows Log P.I. versus time of irradiation

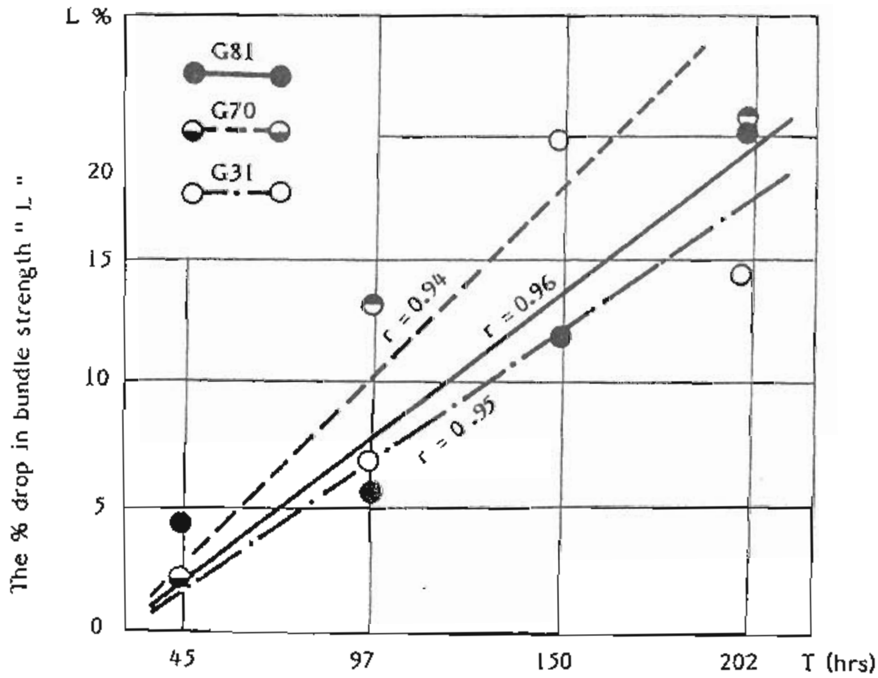

Fig.2: Shows L% versus time of light exposure.

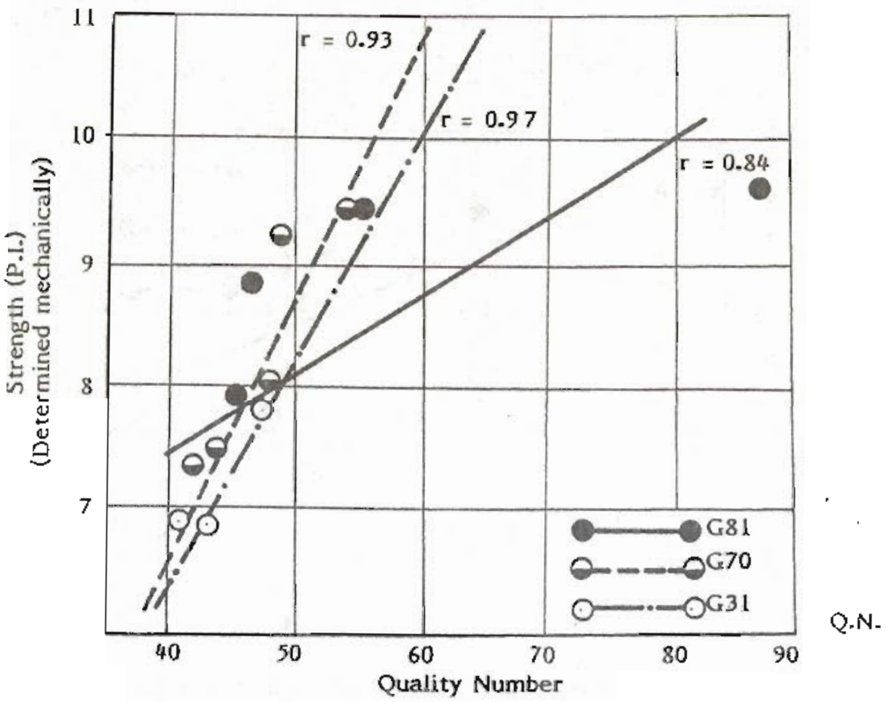

Fig.3: Shows values of strength versus quality number for treated G81, G70, and G31.

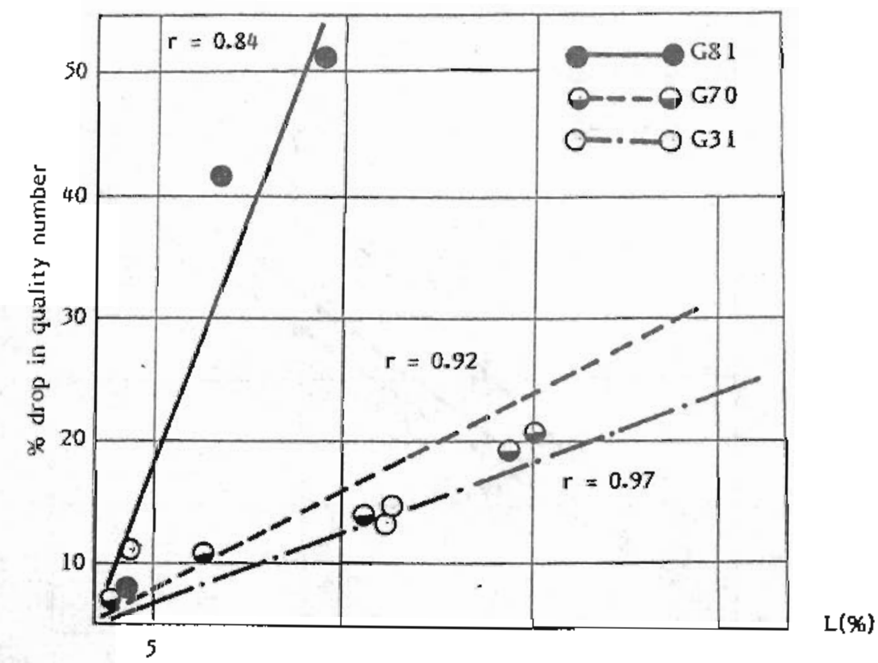

Fig.4: Shows values of % drop in strength versus % drop in quality number.

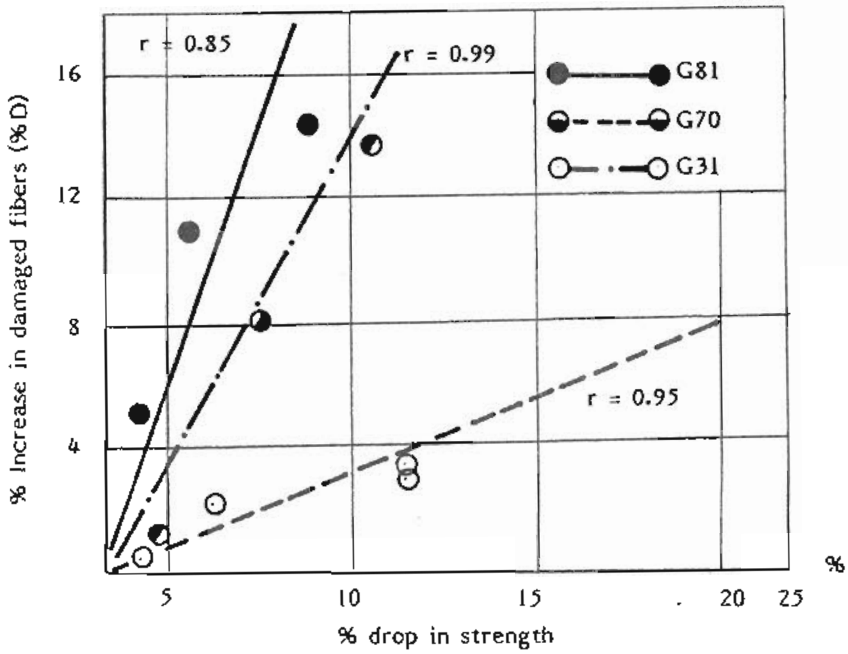

Fig.5: Shows % drop strength versus % increase in damaged fibers (% D).

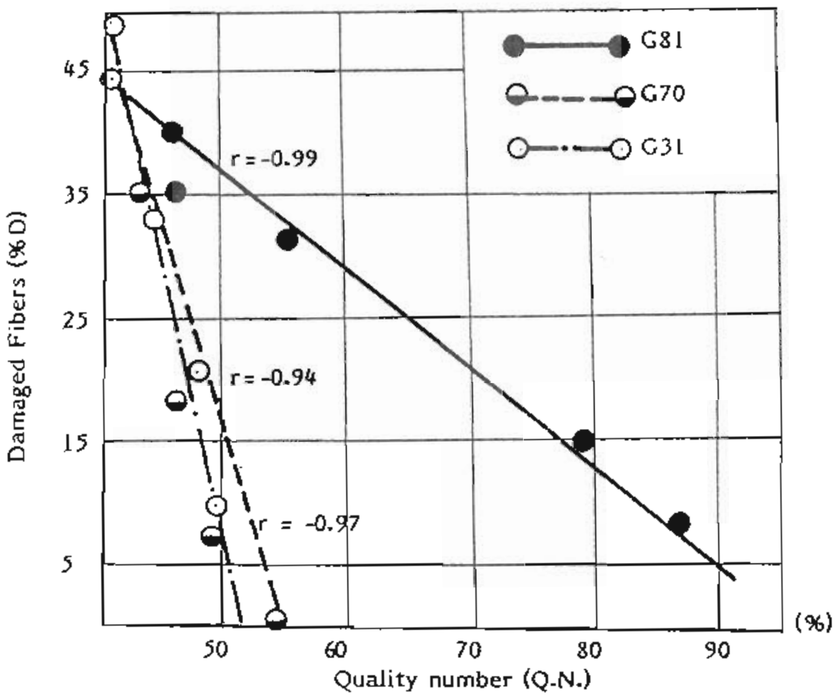

Fig.6: Shows values of quality number versus values of % damaged fibers.