The Use of Talc Powder in Bleaching Cotton Fibers

Mutasim A. Ahmed, Kamal M. Eljack and Muzamel H. Hamed

Faculty of Textiles, University of Gezira

ABSTRACT

It is known that the use of sodium silicate ($Na_2 Si_2 O_3$) in bleaching has some disadvantages such as its high cost, harsh handle of the bleached fabric, and the reduction of the tensile strength of the fabric.

Talc Powder is used in the bleaching of woven cotton fabrics as a stabilizer for hydrogen peroxide (H_2O_2) instead of using sodium silicate. Many experiments were carried out using talc powder at variable condi-tions such as temperature and pH. The same experiments were carried out using sodium silicate stabilizer. Several experiments were carried out on fabrics without a stabilizer.

The bleached samples were tested for whiteness, absorbence, and tensile strength. The untreated samples were tested for comparison. The results of the tested samples were recorded and analyzed using statistical methods.

The study proved that very good whiteness and higher absorbence were obtained when using talc powder, besides that the loss in tensile strength is relatively low. Also it was observed that the softness and handle of fabrics were improved.

INTRODUCTION

Talc Powder is a natural mineral chemical; it is hydrated magnesium silicate of the formula $Mg_3Si_4O_{10}(OH)_2$. It is used as a commodity in a wide range of applications in industry and domestic applications due to its lamellarity, softness and chemical inertness it is also used for thickener, strengthener, filler, applications, carrier lubricant, anti-caking, anti-sticking, cosmetic, adsorbent as well as its use in paints and soaps (British Pharmacopeias, 1993). In textiles it can be used in finishing as softener, stiffener and filler, besides its use in flame retardancy (Reade, 1997).

Textiles are whitened normally by using oxidizing agents such as hydro-gen peroxide, sodium chlorite, and sodium hypochlorite, so as to produce a white background to be ready for dyeing or printing. Cellulosic fibers (cotton) are preferably bleached by hydrogen peroxide in alkaline conditions (Carr, 1995). There are two possible reactions for hydrogen peroxide:-

$H_2O_2 \longrightarrow H_2O + O^{\cdot}$ (I)

$H_2O_2 \longrightarrow H^+ + HO2^-$ (II)

From reaction (II) it is clear that H_2O_2 is more stable in acidic conditions and less in alkaline conditions especially at high temperature. This will lead to strong ionization where per hydroxyl ions are produced in great amounts (high concentration) and oxidation of the cellulose fibres may occur and hence lead to ox cellulose (reduced fibre strength)(Sadov. *et.al* ,1973).

The presence of a stabilizer is very important to regulate ionization; consequently, oxidation may occur only to the impurities present within the fibres. This does not mean that the fibres will not be affected negatively (Trotman, 1984). It is high time to look for another stabilizer to substitute sodium silicate. Since talc is produced locally and is relatively cheap, it will be a good substitute.

MATERIALS AND METHODS

The sample used was a plain weave cotton fabric, of count Ne` 18 (warp and weft), density 40 (ends and picks) per inch.
Laboratory equipment's from the finishing lab. And the quality control lab. Of the Faculty of Textiles, University of Gezira, such as water bath device type LA. 302, and fabric tensile strength device type LA.10, were used.
Purified talc dusting powder (hydrated magnesium silicate) of suitable fineness was used as a bleaching stabilizer. Hydrogen peroxide (35%) was used.
The fabric samples were first purified by desizing with dilute sulphuric acid (0.5%) and detergent. Five gram samples were used. The samples were washed and tested for the presence of starch by starch indicator and also tested for absorbance and tensile strength (Edward., 1983).
Scouring was carried out for each sample by using 5%caustic soda (35 Be'), anionic detergent, and sodium chloride. The bath was heated to boiling for 60 minutes, and washed thoroughly. The samples were finally tested for absorbance and strength. The scoured samples were then bleached using 3% (w/w) H_2O_2 (35%) in the presence of alkali or acid and stabilizer. The pH was adjusted as required. The bath was heated to 80^oc for 75 minutes. After bleaching, the samples were washed with hot water and detergent, and finally washed with cold water and dried.
Many samples were bleached and the conditions and additives were changed as follows:-

- Bleaching in alkaline conditions using sodium silicate at pH (8-10).
- Bleaching in alkaline conditions using talc powder at pH (8-10).
- Bleaching with HCl at pH 4-5 using talc powder.
- Bleaching with acetic acid at pH 4- 5 using talc powder.
- Bleaching with H_2O_2 without stabilizer.
- Bleaching in acidic conditions using sodium silicate.

The samples were dried after bleaching and tested for capillarity as follows:-
A 20 cm strip of each sample was suspended vertically, and the lower part was immersed in a beaker containing a dye solution (0.5%) for 10 minutes. The height of solution in each sample was measured in cm.
All the samples were tested for whiteness using visual test by subject-ing them to a suitable light after laying them on a plain surface, and compared to a white standard.
The samples were also tested for tensile strength, according to the standard procedure (Booth, J.E, 1968), and the readings were recorded.

RESULTS AND DISCUSSION

The results of the different treated and untreated samples for absorbance, strength and whiteness were recorded and analyzed. The following tables show the different results and the discussion relative to them

1. Absorbance

From Table (1) it is clear that talc powder in acidic conditions gave better absorbance than in alkaline conditions, and the same applies to sodium silicate, whilst the results were not significantly different for the two stabilizers at the same conditions. It is clear that both talc and sodium silicate gave better absorbance in acidic medium.

Table (1): The results of capillary tests for talc and sodium silicate at different conditions.

Stabilizer (cm) / Bleached Samples	Talc powder Height of solution		Sodium silicate Height of Solution	
	alkaline	acidic	alkaline	acidic
(1)	7.5	9.0	8.5	9.5
(2)	7.0	9.3	6.5	9.7
(3)	8.0	8.5	7.6	9.6
(4)	7.6	9.2	8.7	9.0
(5)	7.4	9.0	7.8	9.3
Mean	7.5	9.0	7.8	9.4

2. Tensile Strength

Tables (2) and (3) show the effect of bleaching with H_2O_2 when using sodium silicate and talc powder on the strength values in alkaline and acidic conditions. The tensile strength values were assessed for the bleached and unbleached samples.

Table (2) shows significant differences between the results of bleach-ing in alkaline or acidic conditions with and without sodium silicate. The loss in strength in acidic conditions being more when no stabilizer is used. Whereas when sodium silicate is used, it appears to have a positive effect in lowering the strength loss especially in acidic conditions.

When talc powder is used it is clear from Table (3), the fabric strength was reduced when no stabilizer was used both in alkaline and acidic conditions. However the loss in tensile strength was also reduced when talc powder is used especially in acidic conditions.

When the two stabilizers were compared as shown in Table (4), it is clear that while sodium silicate gave better strength than talc powder in alkaline conditions, talc powder gave better strength values than sodium silicate in acidic conditions.

Table (2): The effect of sodium silicate on the strength of the bleached samples in alkaline and acidic conditions.

Strength (Kg) / Bleached Samples	Unbleached Sample	Talc powder		No stabilizer	
		alkaline	acidic	acidic	alkaline
(1)		38.2	41.0	36.5	35.0

(2)	62.9	39.0	42.5	34.0	32.1
(3)		40.8	43.0	33.5	30.0
(4)		34.1	39.0	35.5	33.0
(5)		38.0	37.5	34.8	31.0
Mean	62.9	38.0	40.6	34.8	32.2

Table (3): The effect of talc powder on the strength of the bleached samples in alkaline and acidic conditions

Strength (Kg) / Bleached Samples	Unbleached Sample	Talc powder		No stabilizer	
		alkaline	acidic	acidic	alkaline
(1)	62.9	31.0	43.0	36.5	35.0
(2)		27.0	41.0	34.0	32.1
(3)		36.0	44.0	33.5	30.0
(4)		43.0	42.5	35.5	33.0
(5)		39.0	41.9	33.9	31.0
Mean	62.9	35.2	42.6	34.8	32.2

Table (4): A comparison between the strength of bleached samples using talc power and sodium silicate.

Strength (kg) Bleached Samples	Unbleached Sample	Talc powder		Sodium silicate	
		alkaline	acidic	alkaline	acidic
Mean (average)	62.9	35.2	42.6	38.0	40.6
S.E+		3.3	1.3	3.3	1.3
C.V		6.3	1.06	6.3	1.06

3. Whiteness

All the bleached samples were compared with a white piece as standard, and to each other for whiteness using visual test (three persons participated in the evaluation). Some numerical values are assumed from (1.0 to 3.0) which give indications for the degree of whiteness.

The numbers are as follows: - from 1.0 to 1.4 for low level of whiteness

1.5 to 1.9 good level of whiteness

2.0 to 2.4 very good level of whiteness

2.5 to 3.0 excellent level of whiteness

The results of the degree of whiteness in different conditions are shown in Table (5).

Although both stabilizers gave very good level of whiteness, it appears that talc powder is better in alkaline conditions while sodium silicate is slightly better in acidic conditions

Table (5): The degree of whiteness for the two stabilizers at alkaline and acidic conditions.

Bleached samples	Talc powder		Without stabilizer		Sodium silicate	
	alkaline	acidic	alkaline	acidic	alkaline	acidic
(1)	2.5	2.2	1.7	2.0	2.2	2.4

(2)	2.4	2.2	1.5	1.9	2.1	2.4
(3)	2.5	2.3	1.4	1.7	2.2	2.3
(4)	2.4	2.1	1.5	2.0	2.3	2.2
(5)	2.3	2.2	1.4	1.8	2.1	2.2
mean	2.4	2.2	1.5	1.9	2.2	2.3

CONCLUSION

From the results and discussion the following can be concluded:-

1. The objectives of bleaching such as (whiteness and absorbance) can be obtained when talc is used as stabilizer.
2. Bleaching with talc powder as stabilizer gives higher degree of absorbance especially in alkaline conditions.
3. In acidic conditions, talc powder gives low loss of fabric strength compared to sodium silicate.
4. The loss of fabric strength is higher for talc powder in alkaline conditions than sodium silicate.
5. The degree of whiteness obtained for talc powder is better than that of sodium silicate especially in alkaline conditions.
6. From the above it is clear that bleaching with talc powder as stabilizer for hydrogen peroxide is very encouraging especially when considering it's relatively low cost and availability in the local market.

REFERENCES

BOOTH, J.E. (1968). Principles of Textile Testing (Third Edition). Butter Worth and Co. Publishers, London PP- 432

British Pharmacopeias. (1993). (Volume 1, and Volume 2), Printed in United Kingdom, London, pp: 449, 1119, 993.

CARR, C.M. (1995) Chemistry of the Textile Industry (First Edition). Blakie Academic and Professional, an Imprint of Chapman and Hall, London.

EDWARD.S. OLSON. (1983). Textile Wet Processes (Volume 1), Nye's Publication, United States of America, PP: 127, 154.

Elnagawi, A.F (1981). Finishing of Cellulosic Fabrics, Egypt Dyers Company, Alexandria.

Leven. R and Prozan. R. 1992. Journal of the Society of Dyers and Colorists, (Volume 108) P.O Box 244, Perkin House 82 Grattan Road, Jerusalem, PP. 375. 381

Reade. 1997. Reade Advanced Materials, e-mail: web master @ read. Com, File LLA: 1 Talc powder from READE. Htm, Latin America

Sadov, F. Rorchagin. M. and Mateshy. A. 1973. Chemical Technology of Fibrous Materials (English Edition).

Trotman, E.R. 1984. Dyeing and Chemical Technology of Textile Fibres (Six Edition). Charles Griffin and Company LIM, Printed in Great Britain and Sons Limited, England, PP 152 – 187, 217.

الخلاصة

ان الهدف الأساسي لهذه الورقة هو تطوير نموذج رياضي يساعد في ايجاد التنبوءات بكمية المياه المتوقعة إستخدامها لاغراض الري وهذا النموذج يعتمد أساساً على طريقة السلاسل الزمنية بمكونات ثلاثة هي الانحدار والدورية والعشوائية .

تم تطبيق هذا النموذج على محاصيل القطن والتي تزرع بالسودان (بركات شمبات وأكالا) حيث استخدمت عدة تقينات لاجراء المحاكاة الرياضية في السلاسل الزمنية الأمر الذي ساعدنا في الكشف عن وجود بعض الظواهر من عدمها (الانحدار) حتى تمكنا من ايجاد علاقة رياضية مبنية على الدورية والعشوائية.