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EFFECTS OF PLAIN, TWILL AND SATEEN DESIGNS BEFORE AND AFTER TREATMENT WHEN EXPOSED TO DUST

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ABSTRACT

This study is conducted to produce anti-dust fabrics by using three different types of materials: cotton (%100), polyester (%100) and a blend of cotton and polyester (%50 for each). However, these materials are woven into various fabric designs: plain, twill 2/2 and sateen 4 extended from the weft. These materials are treated with a chemical substance. Standard tests were used to determine the rate of change in mechanical and physical properties of the fabrics before and after treatment with the chemical substances to assess their air permeability and weight following their exposure to dust before and after treatment. After chemical treatment of the fabrics with anti-dust substance their ability to expel dust improved and their efficiency of dust expelling becomes 97%.

Keywords: Plain; Twill; Sateen; Treatment; Dust; Weight and Air Permeability

1. INTRODUCTION

The haboob, a violent dust storm, can occur in central Sudan when the moist southwesterly flow first arrives (May through July). The moist, unstable air forms thunderstorms in the afternoons. The initial down flow of air produces a huge yellow wall of sand and clay that can temporarily reduce visibility to zero.[1]

Sudan has a tropical climate. Summer temperatures often exceed 43degrees Celsius (about 110 degrees Fahrenheit) in the desert zones. Dust storms frequently occur in desert zone. High temperatures also occur in the south throughout the central plains region, but the humidity is generally low. In Khartoum the average annual temperature is about 26C° Celsius (about 80° Fahrenheit), and the annual rainfall is about 254 mm (about 10 inch).[2]

No doubt, the scientific achievement of humanity in the two previous centuries enabled the mankind to live in different climatic regions, however, these variations in climates require a variation in clothing .People produce different types of clothes using a diversity of fabrics. These fabrics at the same time are subjected to dust, which is different in type according to the physical and chemical components of the dust particles and this in turn could affect the fabrics.

The word (dust) is used generically to describe fine particles that are generally less than 75 microns (µm) in diameter and that can be transported in the atmosphere. Dust in the urban environment commonly includes sources from industry, vehicles, coal and wood smoke, and particles from the soil. Typically, the dust associated with aggregate operations consists of particles from exposed soil and rock. The presence of dust sometimes raises concerns that are not directly proportional to its impact on human health and the environment. Dust concentrations, deposition rates, and potential impacts tend to decrease rapidly away from aggregate operations. Federal, state, and local regulations put strict limits on the amount of airborne material that may be released from an aggregate site, especially dust that could be inhaled.[3]

Dust consists of solid particles projected into the air by natural forces such as wind, volcanic eruption, or earthquakes, or by human activities. Fumes are solid airborne particles usually 100 times smaller than dust particles, commonly formed by condensation of vapors of normally solid materials. Fumes that are permitted to age tend to agglomerate into larger clusters.

Dust was defined as particulate matter which is/ or can be suspended into the atmosphere as a result of mechanical, explosive, or windblown suspension of geologic, organic, synthetic, or dissolved solids and does not include non-geologic particulate matter emitted directly by internal and external combustion processes.

2. MATERIALS and METHODS

2.1 Cotton

Cotton is now our chief vegetable fiber, the yearly crop being over six billion pounds, of which the United States raises three-fourths. Texas is the largest producer, followed by Georgia, Alabama and Mississippi. The remainder of the world supply comes chiefly from India, Egypt, Russia, and Brazil. The Hindoos were the first ancient people to make extensive use of the cotton fiber. Not until the invention of the cotton gin by Eli Whitney in 1794 when the cotton begins to reach its present importance. Only four or five pounds of the fiber could be separated by hand from the seed by a week's labor. The modern saw gins turn out over five thousand pounds daily.[4]

Cotton accounts for half of the world's consumption of fibres and is likely to remain so owing to many of its innate properties and for economical reasons that will not be discussed here. Cotton is made of long chains of natural cellulose containing carbon, hydrogen and oxygen otherwise known as polysaccharides. The length of the chains determines the ultimate strength of the fibre.

2.2 Polyester

Polyester fiber is the long chain polymer produced from elements derived from coal, air, water and petroleum.[5] Polyester is a thermoplastic fiber and has good strength. It melts in flame and forms a grey hard non-crushable bead. It is an easy care fabric and can be easily washed.

Generally each company produces its own variety of polyester through modifications under specific trademarks. The Principle raw material is ethylene diamine.The terepthalic acid is obtained from petroleum.

2.3 Weaving

Fabrics are produced mostly from yarns. Few fabrics are directly produced from fibers. In Indian market 70% of the fabrics are produced by weaving. Among the other fabrics there is a nonwoven fabric and lace making that worth mentioning along with needle punched and tufted fabrics. Felts are fabrics made directly from fibers without making yarns where their uses are mostly emerging now a days.

2.3.1 *2.3.1 Plain weave*

Plain weave is the simplest of all the weaves. About seventy percent of the woven fabrics available in the market today are woven in plain weave or its variations.

The most two-dimensional woven technical fabrics are constructed from simple weaves and of these at least 90% of them use plain weave.[6]

Plain weave fabrics have no right or wrong sides. Plain weave provides a wide scope for introducing variations in the fabrics by use of yarns of different colours, different textured yarns and also by use of thick and thin yarns. Fabrics can be produced in large variety, with different degrees of yarn twist and with different degrees of tensions in the loom. Fabrics made by tightly twisted warp and loosely twisted weft make it easy for a napping finish to be given to it.

2.3.2 *Twill Weave*

Twill made by running both warp and filling under one and over three threads is called a swans down twill and the reverse is known as the crow weave. In these the diagonal twilled effect is much more marked. Various twills are often combined with each other and with plain weave, making a great variety of texture. Numerous uneven twills are made, two over and three under, etc.

Twill is a weave that repeats on three or more ends and picks and produces diagonal lines on the face of a fabric. Such lines generally run from selvedge to selvedge.[6]

2.3.3 *Sateen Weave*

In the sateen weave, nearly all of either the warp or the filling threads are on the surface, the object being to produce a smooth surface fabric like sateen. With this weave it is possible to use a cotton warp and silk filling, having most of the silk appear on the surface of the fabric.

To avoid twill lines, satins and Sateens have to be constructed in a systematic manner. To construct a regular satin or sateen weave without a twill effect a number of rules have to be observed. The distribution of interlacing must be as random as possible and there has only to be one interlacing of each warp and weft thread per repeat, which is per weave number. The intersections must be arranged in an orderly manner, uniformly separated from each other and never adjacent.[6]

Table 1. Specifications of samples

Fabric material	100%Cotton		
Weave	Plain	Twill2\2	Sateen4
Warp count(Ne_1)	40\2 s	40\2 s	40\2 s

Ends\cm	36	36	36
Weft count(Ne_2)	24 s	24 s	24 s
Picks\cm	21	21	21
Fabric material	**100%Polyester**		
Weave	Plain	Twill2\2	Sateen 4
Warp count(Ne_1)	40\2 s	40\2 s	40\2 s
Ends\cm	36	36	36
Weft count(Ne_2)	24 s	24 s	24 s
Picks\cm	21	21	21
Fabric material	**50%Cotton &50% polyester**		
Weave	Plain	Twill2\2	Sateen 4
Warp count(Ne_1)	40\2 s	40\2 s	40\2 s
Ends\cm	36	36	36
Weft count(Ne_2)	24 s	24 s	24 s
Picks\cm	21	21	21

3. Experimental Work

3.1 Chemical Treatment:

Emulsion copolymer of perflouro –heptyl acrylate-co-methylol acrylamide .3% emulsion +dihydroxy diethylene urea + NH_4cl as catalyst for thermo fixation. Drying at 140° C for 1 minute.

3.2 Weight Test

Can be expressed as the weight of the cloth to one of the two methods, namely the weight per unit area or weight per unit length, and in all cases, you must specify the method of estimation and the unit weight and the unit of measurement used.

There are a range of factors that affect the process of assessing the weight and that must be taken into account such as the accuracy in determining the sample size and accuracy of the sample cut and in the process of weight. The percentage of moisture in the fabric is one of the direct impact on the accuracy of the results of estimating the cloth weight factors.

The method of obtaining this value was achieved by using SHIMADZU digital scale with a precision of up to 0.01g .Samples were cut from the fabric.

The samples were cut with circular samples cutter, which gives an area of $100cm^2$ for each sample.

The scale digital reading gives directly the fabric weight per $1m^2$ .The average weight was determined of five samples cut from different places of the fabric not including selvedges. This method was performed according to the standard ASTM 3776-85 (1990).

3.3 Air Permeability test

The definition of air permeability of fabric is the air measured by the volume of air in cubic centimeters that passes per second through a square centimetres of fabric at the air pressure of 1 cm of water. The sample is installed in the path of the suction stream of air through the pump device, it is controlled by the amount of air pressure flowing through the valve in order to reach a desired pressure and using the indicated amount of air pressure passing. The test sample is placed into a box where exposed to air stream which passes through the circular diameter of 1 inch. The readings of the device is recorded through a number of glass tubes containing moored on buoys cork Light and which are affected by the air stream, that passes through the samples. The reading is determined by the float level.

The apparatus used for air permeability testing is FRAZIER permeability tester shown in figure 2.8 by using BS NO.5636 (1990).

3.4 Fabric Dust Permeability:

The dust permeability of fabrics is determined by a simple apparatus, which was newly designed by Dr Mohamad Saad in Textile Department, National Research Center, Cairo.

The main purpose behind the design and development of the concerned apparatus is to ensure the efficiency and durability of filter fabrics to avoid risking failure when a proposed filter is introduced.

Using such apparatus may lead to minimizing the cost and to take correct decisions in selecting filter fabrics.

All fabrics tested were successfully used as bag filters in number of filtration applications, where woven and non-woven fabrics are used.

4. Results:

Table 2. Plain fabrics when exposed to dust before and after treatment

Material	**Weight of m^2 (g)**	
	Before Treatment	After Treatment
	After exposed to dust	
100 %Cotton	191	196
100%Polyester	271	280

50%cotton&50% polyester	210	217

Material	Air permeability ($cm^3/s/cm^2$)	
	Before Treatment	After Treatment
	After exposed to dust	
100 %Cotton	4.8	4.0
100%Polyester	2.8	1.8
50%cotton&50% polyester	5.1	3.5

Table 3. Twill fabrics when exposed to dust before and after treatment

Material	Weight of m^2 (g)	
	Before Treatment	After Treatment
	After exposed to dust	
100 %Cotton	190	192
100%Polyester	185	190
50%cotton&50% polyester	183	208

Material	Air permeability ($cm^3/s/cm^2$)	
	Before Treatment	After Treatment
	After exposed to dust	
100 %Cotton	21.3	17.1
100%Polyester	23.5	16.0
50%cotton&50% polyester	19.7	14.0

Table 4 Sateen fabrics when exposed to dust before and after treatment

Material	Weight of m^2 (g)	
	Before Treatment	After Treatment
	After exposed to dust	
100 %Cotton	181	189
100%Polyester	181	185
50%cotton&50% polyester	205	215

Material	Air permeability ($cm^3/s/cm^2$)	
	Before Treatment	After Treatment
	After exposed to dust	
100 %Cotton	22.2	19.3
100%Polyester	30.5	22.0
50%cotton&50% polyester	20.7	22.5

The effects of design of fabrics on the weight are shown in figure (1) Plain design fabric got the highest value after being treated and exposed to dust. The process of treatment had added some weight to the fabrics.

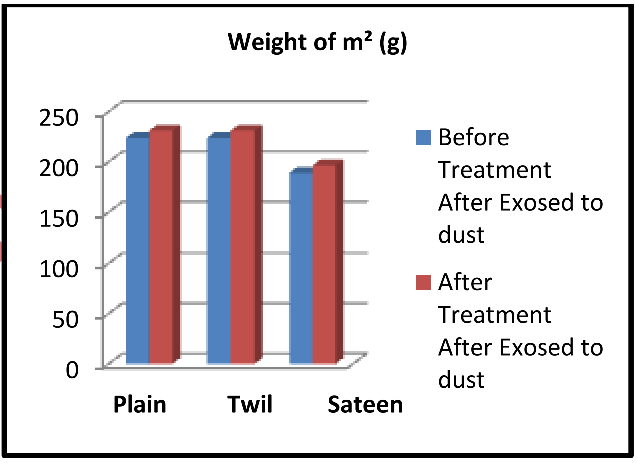

Fig (1) Weight of m^2

The results of the effects of design of fabrics on the property of air permeability before and after treatment when exposed to dust. Sateen design fabric got the maximum value when treated and exposed to dust. Because of its loose constructed design. The dust particles has deposited between the pores of the fabric. Plain weave got the lowest value due to its high compactness as shown in figure [2].Table [5] shows the efficiency of expelling and the efficiency of sticking before treatment, while table [6] shows the efficiency of expelling and that of sticking after treatment. The efficiency expelling before and after treatment is drawn in figure [3]. It is clear from figure [3] the significant improvement of the efficiency of expelling after the treatment.

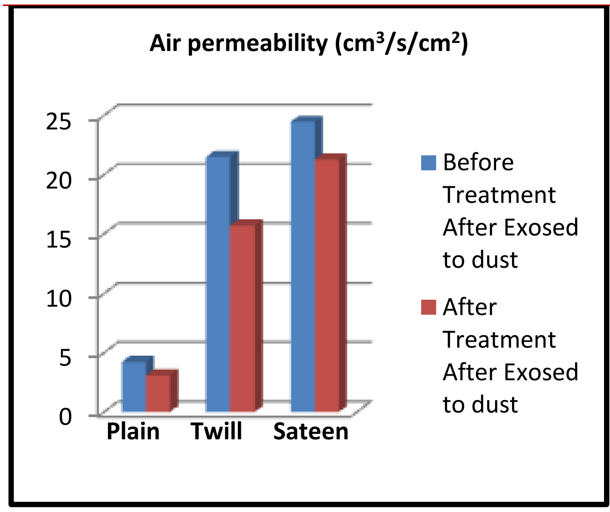

Fig (2) Air Permeability

Table5.Efficiency of Expelling, Sticking Dust and Dust Pass through the Porous before treatment

Efficiency of sticking dust	Efficiency of expelling dust	Efficiency of dust pass through the porous
52.6852	47.3000	0.0148
52.9345	47.0000	0.0655
54.2317	45.7000	0.0683
54.6000	45.3000	0.1000
52.2700	46.9000	0.8300
53.3100	45.8000	0.8900
53.8300	46.0000	0.1700
53.1600	46.1600	0.6800
52.3400	46.9600	0.7000

Table6.Efficiency of Expelling, Sticking Dust and Dust Pass through the Porous after treatment

Efficiency of sticking dust	Efficiency of expelling dust	Efficiency of dust pass through the porous
1.48769	98.5000	0.01231
2.74492	97.2000	0.05508
2.54062	97.4000	0.05938
5.19446	94.8000	0.00554
1.95077	98.0000	0.04923
2.83231	97.1000	0.06769
2.48923	97.5000	0.01077
2.75692	97.2000	0.04308
2.23077	97.7000	0.06923

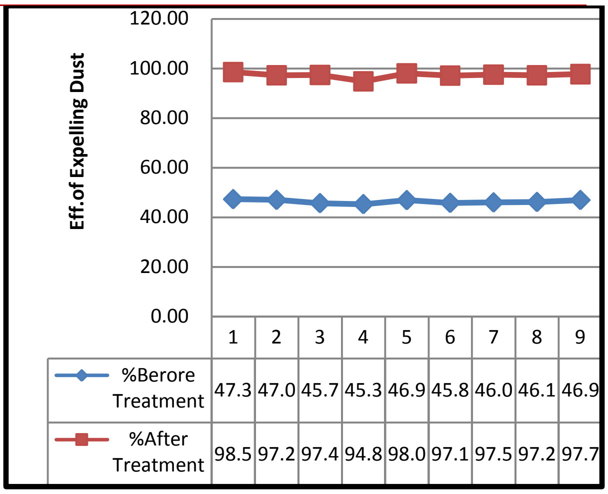

Fig (3) Efficiency of Expelling Dust before and After Treatment

Key:

1= cotton in plain design.
2= cotton in twill design.
3= cotton in sateen design.
4= polyester in plain design.
5= polyester in twill design
6= polyester in sateen design
7= 50%cotton&50% polyester in plain design
8=50%cotton&50% polyester in twill design
9=50%cotton&50% polyester in sateen design

5. CONCOLUSION

Sateen weave got the highest value of air permeability before and after treatment, while the plain weave got the lowest value of air permeability before and after treatment.

It was found that the 100% cotton plain fabric got the maximum expelling 98.5% efficiency while the 100% polyester twill fabric 98% comes next and the blend of 50%cotton and 50% polyester sateen fabric comes third 97.7%.

6. ACKNOWLEDGMENTS

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7. REFERENCES

[1]. LL.M Mohamed H.Fadlalla, "Short History of Sudan", New York,2004,pp.63.

[2]. http://www.world66.com/africa/sudan/climate.

[3]. Hazard Prevention and Control in the Work Environment: Airborne Dust. Protection of the Human Environment Occupational Health and Environmental Health Series, Geneva, 1999, World Health Organization WHO/SDE/OEH/99.14: English only

[4]. Kate Heintz Watson, "Textiles and Clothing", Chicago,1907,pp.31.

[5]. Chi-Wai Kan, "A Novel Green Treatment for Textiles", US,2015,pp.22.

[6]. R Horrocks and S C Anand, "HANDBOOK OF TECHNICAL TEXTILES", Englan, 2000,pp.63,66,