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A STUDY ON IMPROVING PROPERTIES OF SUMMER SHIRT FABRICS VIA USAGE OF MICRO FIBERS

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ABSTRACT

Rapid evolvement of technology is synchronized with the change in the ozone layer, and what followed it from changes in the global climate, which forced the world to turn to produce more comfortable clothes to overcome the hot weather problems.

The research focuses on the study of the influence of adding micro fiber to cotton during weaving process and what follows that from changes in the blending ratio, as well as studying the properties of the final product in order to acknowledge the advantages and disadvantages and finding out the best blending ratio to achieve the highest level of required characteristics in summer clothes specially male shirts.

Keywords: Air permeability, Blending , Comfort , Flexibility , Microfiber.

I. INTRODUCTION

The industry of manufacturing summer shirt fabrics consumes a huge interest either from its manufacturers or researchers due to its major importance in the fabric field as a whole, that's because of the rapid consumption of these fabrics and the diversity of its designs, such evolvement has not only stopped at improving the machines used in the field of textiles (spinning and weaving),but it extended to the raw materials used as well as the material mixes used in the field and the expansion in its uses. The research aims at reducing the cost of the final product in an attempt to achieve all the consumer economical and aesthetical needs.Cotton is considered the main material used for manufacturing summer shirts,because of its special specification that are appropriate for summer weather.

First of these specifications is comfort, comfort has multiple definitions, Bekesius define it "as the state of affair that lacks discomfort and agitation,and it's one of the happiest natural means of existence" [1]. Best Gordon attempted several trials to approximate the distance among the fiber types and the construction of tissues and the effect they hold on comfort [2].

There has been a huge leap in accepting usage of constructive fibers within the latest years, Micro fibers have helped in making this leap because of its admired texture,high endurance ability, and its adherence to the factor of comfort. It has been evolved recently to produce comfortable fabrics that simulate its natural alternative.Micro fibers are constructed from a combination of Polyester, Polyamide, Polyacrylic and Viscose . Sometimes cotton, linen and wool can be thrown into the formula.Threads produced from very delicate fibers

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are very adequate for the production of stretchy cloth. Micro-fibers are characterized by creases and undulations which allow a high permeability for air which reflects upon the performance.

Micro-fiber is the term that refer to fibers less than one Denier (1.0 Denier) or less than one Dtex (1.0 dtex) . The fibers differ from each other in thickness and smoothness.

1. Comfort:

Comfort is definitely a multi level concept with its various references, that is why the holistic notion of comfort has been a major concern to scientists and researchers related to the fields of design, quality control or productionof clothes, especially those designed for specific purposes.

That is why the main role of those specialized in design, manufacturing, quality measuring of the products, to specify the main requirement of the Industrial product that has to achieve during performance. That is plausible to being comfortable while donning on the clothes, in short term what is known scientifically as Comfort Requirement.

Next is an explanation to comfort definition and the different aspects of it:

1.1. The meaning of Comfort:

The concept of " Comfort" is very broad and comes with various definitions **,**Sultan **[**3] cleared that sense of comfort in clothes is considered a subconscious feeling. Where " Mann& Barfield " [4] reached to define comfort that it is lack of aches while donning the garment .

Yuglue [5] point of view is that physical definitions are not sufficient for describing comfort. The factors affecting comfort are shown next:

(1) **Physiological and Psychological Factors:**

Such as Humidity transfer, Perspiration, Air, Heat, and the Psychological state of the person and his type of activity .

(2) **Physical Factors:**

It includes thread composition, material type , woven structure , thread number , texture, how adaptive to current trends , finish , ease of movement and ease of donning [6] .

1.2. Types of Comfort:

The notion of comfort can divided to several types:

1.2.1. **Thermo physiological comfort ;**

This type of comfort depends on the extent the clothes can be affected by heat, humidity, air, and the body reaction to the fabric texture. The awareness of clothes nature usually leads to discomfort as in feeling extreme *heat*, cold, wet, or even humidity [4,7]

Nabiha Ali Kotb adds that physiological easiness or comfort arise from the fitness of the garment to the body, that feeling extend to how appropriate is the garment to the context in which it is worn, that extends to the current trend, color, constructive build of the fabric, and preparation method [8].

1.2.1.1. Conditions of achieving Thermo Physiological comfort in Garments :

Thermo physiological comfort depends on what is called "**Micro climate**" that is the climate existent between the skin and the inner layer of clothes, in order to achieve maximum comfort the micro climate must be:

Temperature : 35+/-2 Celsius, Relative Humidity : 50 +/- 10% and Wind speed : 25+/- 5 mile per second m/s.

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Awareness of thermal comfort and degree of moisture depends on the transfer degree of heat and humidity through fabric. The cloth must have high capacity for thermal isolation and permeability for water vapor as well as the capacity for absorbance, and several other specifications related to thermal comfort [9].

1.2.2. Sensorial Comfort :

It is about the degree of easiness the person experience while donning the garment. It is a known fact that the buyer judge the clothes by texture, that is because the texture has a direct relation to feeling comfortable while wearing the clothes [10,11].

1.2.3. Body Movement Comfort :

This type of comfort is about body movement flexibility, and the decrease of load or pressure over the body, while retaining its shape. Persons wearing the clothes should feel unbound, comfortable clothes should not hinder movement, hindered movement cause escalating pressure hence the feeling of discomfort .

1.2.3.1. Conditions of Movement Comfort :

1- Flexibility: Garment fabric should be flexible, it should adapt to the skin movement, expand and shrink according to use.

2- Elongation: Elongation of the cloth should not be less than 15%, fabrics that are less than that ratio is considered a stiff fabric, while the fabric that is above that ratio is capable of the required expandability, body contiguous garments needs elongation ratio between 15 - 25% , in order to achieve the required comfort..

3- Weight: Weight contribute to the sense of comfort or the lack of it [4,11] .

2. Microfiber

An important type of synthetic fiber is known as Microfiber. It has a quality of being very fine, finer than one denier or Decitex/thread. It has a very small diameter smaller than the diameter of a silk thread that has a diameter half that of a single strand of human hair. Basically polyamides, polyesters or a conjugation of both used to manufacture the most common types of Microfiber, each conjugation of different shapes, and sizes of synthetic fibers are elected for a specific industrial purpose required in the final product such as the degree of softness., absorption, toughness, water repellency, and electrostatics, and so forth. Microfiber characteristics qualify it to be the perfect implement for cleaning and sanitizing , it has the ability to reach to the narrowest openings of a surface, The fiber broad surface and it's unique star shape allows higher absorption than that of other material such as cotton or paper, that could reach up to 7 times its weight. Microfiber cloth generates a static charge that attracts dust particles and locks it inside of it, instead of stretching it across a surface or even spreading them in to air. Microfiber as the name suggest applies to fibers that are thinner than 1.0 denier, the thinner the fiber the more efficient it is. Some of the highest quality fibers measure as thin as 0.13 denier.

2.1 Benefits of Microfiber:

1- To sum up the qualities of Microfiber, it has the ability of eliminating microbes and germs of surfaces , multiple studies and researches proved beyond doubt that surfaces cleaned with microfiber cloth are 99% free of germs, unlike those cleaned with common cotton cloth were only 30% free of germs and bacteria.

2- Being produced in different colors, that can help determining a certain colored microfiber cloth for cleaning a certain area without mixing it for cleaning another one. For instance yellow colored microfiber cloth can be

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used for mopping floors, and pink colored ones are used for cleaning kitchen counters, thus preventing transmission of bacteria or cross contamination.

3- Because microfiber cleaning does not require a great amount of water or chemical products, being efficient as above-mentioned, it helps in water reservation, less toxic materials released in the drain system. Also being easy to handle it saves more man power, or any possible injuries sustained during the cleaning process. [13, 14]

II EXPERIMENTAL WORK

Five samples have been produced using :

-Warp specifications: cotton yarns, 40/1, 38 threads/cm.

- Picks specifications: cotton yarns, 36/1 , *Polyster yarns 150 /1 Denier (288 fibers)* , 29 picks/cm on loom which is equivalent to 31.5 after finishing.

The number of throws is unified in all samples 29 weft / cm Linear regression equations that connects the factors subject to study to tested properties have been determined, as well as the incorporeal ties in between them.

Table (1) : Samples Parameters

Samples	The blended percentage for wefts
Sample (A)	100% cotton
Sample (B)	75% cotton : 25% polyester
Sample (C)	50% cotton : 50% polyester
Sample (D)	25% cotton : 75% polyester
Sample (E)	100% polyester

III. RESULTS AND DISCUSSION:

Results of the experimental tests carried out on samples under study are presented in the following tables and graphs. Results were also statistically analyzed for data listed and relationships between variables were obtained.

Table (2) : Weight and thickness results

sample	Fabric square meter weight in gm	Thickness p. mm
A	122.5	0.3
B	*123*	*0.3*
C	123.8	0.3
D	124.2	0.3
E	125	0.3

Table (3) : Tensile strength and elongation results

samples	warp tensile strength in kgm	weft tensile strength in kgm	elongation warp	elongation weft
A	339	237	24.23	17.63
B	357	248	22.53	26
C	364	458	20.5	41.56
D	365	646	20.2	45.8
E	371	816	19	48

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Table (4) : Stiffness, Air permeability and : water vapour permeability results

sample	Stiffness in warp direction	Stiffness in weft direction	Air permeability	Relative water vapour permeability %	Absolute water vapour permeability Pa. m^2 .w^{-1}
A	43.85	38.97	504.6	60.6	2.8
B	45	41.87	444.6	61.1	2.8
C	45.7	44.9	347.4	61.98	2.64
D	47.4	45.7	312.4	62.74	2.54
E	47.7	46.6	249	64.42	2.38

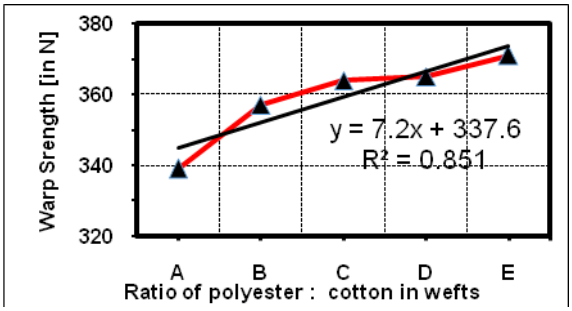

Fig. (1) Relation between polyester and cotton weft yarns blending ratio and warp tensile strength

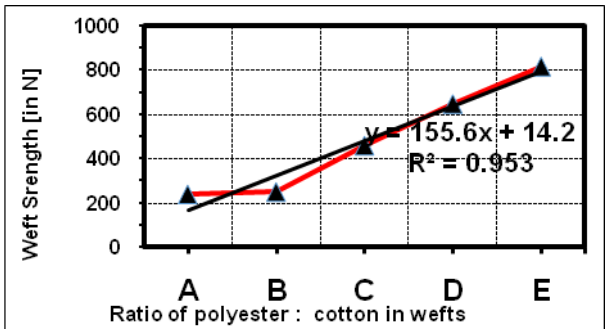

Fig. (2) Relation between polyester and cotton weft yarns blending ratio and weft tensile strength

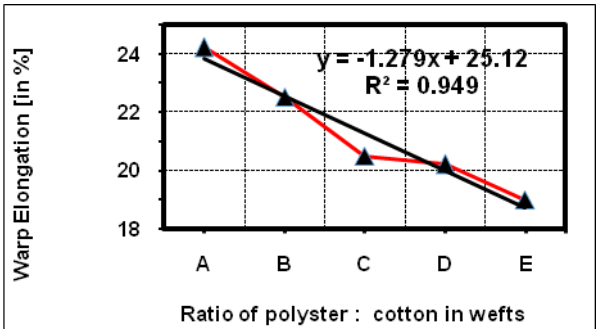

Fig. (3) Relation between polyester and cotton weft yarns blending ratio and warp elongation

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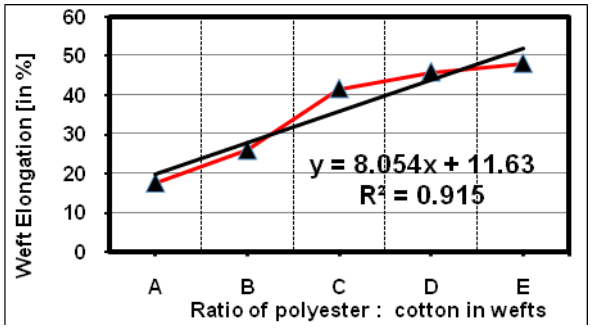

Fig. (4) Relation between polyester and cotton weft yarns blending ratio and weft elongation

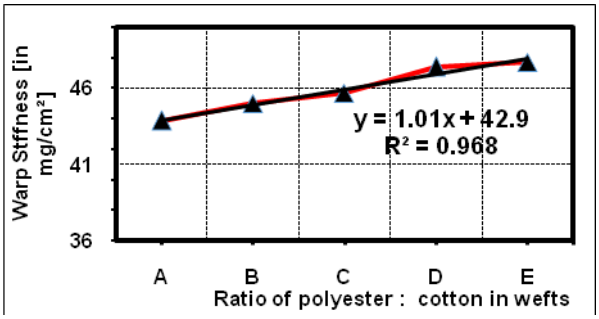

Fig. (5) Relation between polyester and cotton weft yarns blending ratio and warp stiffness

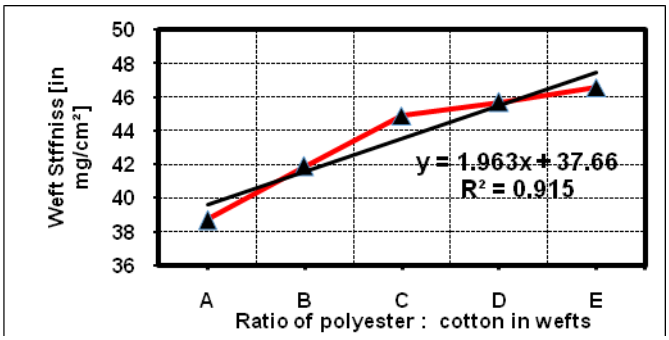

Fig. (6) Relation between polyester and cotton weft yarns blending ratio and weft stiffness

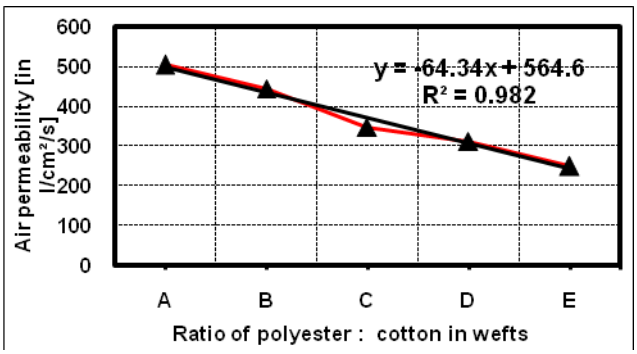

Fig. (7) Relation between polyester and cotton weft yarns blending ratio and fabric air permeability

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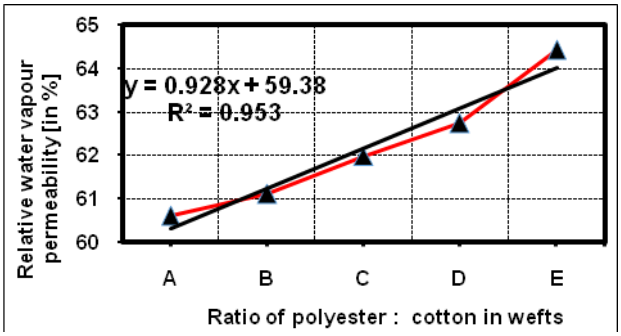

Fig. (8) Relation between polyester and cotton weft yarns blending ratio and Relative water vapour permeability of fabric

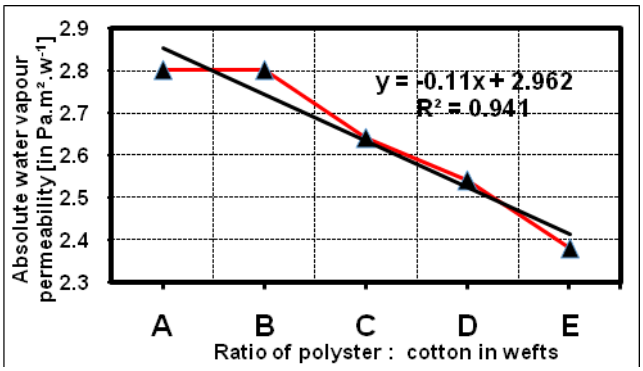

Fig. (9) Relation between polyester and cotton weft yarns blending ratio and Absolute water vapour permeability of fabric

After the statistical analysis for the tests results, the factors of influence based on the research variable (Cotton to Polyester ratio in warps) have been deduced, and they are as follow :

1- Fabric square meter weight : It is clear from table (2) , that the differing weft materials has almost no effect over the weight that is due to usage of the equivalent number in the cotton and polyester warp.

2- Fabric Thickness: It is obvious from table (2) that the thickness was not affected by the change in warp material, because of the proximity of cotton and polyester numbers.

3- Tensile strength: It can be seen from table (3) and fig. (1) that the correlation coefficient **R** and the equation show the change in the effect of the tensile strength in the direction of the warp by a simple percentage 9.5% as we increase Polyester wefts over the cotton wefts, that is due the difference in the two threads perimeters, alongside the effect that the high density of the little threads (288 little thread) has on the increase of the fraction with warp threads at the cross section points , that help to increase thread endurance for strains as a result to the tests .

It was also found from table (3) and fig. (2) That the equation and correlation coefficient **R** show the effect of the increase in Polyester weft ratio over cotton wefts. That increase affect the tensile strength in weft direction, that is too due the number of the little threads and the friction in between them which increase the tensile strength necessary for tear.

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4- Elongation: It is clear from table (2) and fig (3), (4) the positive effect of increasing the polyester wefts ratio over cotton. The high density of the little threads promote the sliding of small thread before tear, which increase the elongation ability of the fabric as a whole.

5- stiffness : It is obvious from table (3) and figs. (5), (6) that, the sample results of solidity test show no effect made by the increase of polyester warps on the solidity of the fabric, that's due to number similarity in both polyester and cotton. On the other hand the solidity of the fabric increased by the increase of polyester warps in the direction of weft, because of the number of little threads existent in polyester thread is higher than its colored equivalent in cotton thread.

6- Air Permeability: It is clear from table (3) and fig. (7) that, the effect the increase of polyester wefts ratio over cotton wefts has on reducing the fabric air permeability. The regularity of polyester threads reduce the rate of fabric air permeability. While the bean shaped cotton thread and its twirl increase the inter space between the wefts threads and as a result the fabric air permeability.

7- Water Vapor test: It can be seen from table (3) and figs. (8),(9) , Correlation coefficient **R**, and the equation show the type of effect the increase of polyester weft ratio over cotton one, on fabric ability to water vapor. The results show that there was not much of an effect that is due to the high density of little threads thus the increase in little thread surfaces inside the single thread and as a result an expanded surface to the threads which allow the suffusion of water vapor over the fabric surface .

IV. CONCLUSIONS

The mix between cotton threads and microfiber polyester thread allow a variety of results that are different than these achieved by using 100% cotton threads only. The results are a diversity of major fabric characteristics, which give a chance to the possibility of using every mix ratio to achieve the required characteristic in the time in which it is needed and to perform the task it is meant by.

- The product - *subject of this study*- is characterized by using cotton as a fixed material in warp threads, that's to maintain a suitable level of utilization required in clothes, for cotton is a popular material that has unanimous characteristics.
- The diversity in weft material in this study led to applying several new mixture ratios between cotton and polyester and studying the results of these blends and its effect on the produced fabric characteristics.
- The usage of Microfiber Polyester threads instead of the regular type led to achieving a better results in the outcome product which is clear in both of the solidity test and water vapor test.
- The product - *subject of this study*-has a duration longer than 100% cotton material, that was proven during the pull power test and elongation test. This result was achieved via increasing the ratio of microfiber wefts number over that of cotton wefts.The blend result in minimizing the cost of the product, as well amending for the shortage of cotton material in Egyptian market.
- The results allow a variety of choices between several blend ratios that would achieve the required cost and quality, by changing the ratio of the blends resulted in diversity of outcome especially during air permeability test, where the results clarified that applying a 100% cotton warps allows a 100% air permeable fabric more than

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when applying a microfiber polyester warp. This result is efficient in determining the required final product and its utilization in the conditions where and when it is most suitable.

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