



Effect of some construction elements on the functional performance of selected winter's men shirts fabrics

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ABSTRACT

Textile industry is a necessity for human existence, and it takes the lead among other consumer industries all over the world. Clothes is considered one of the most important textile products, it conform the largest section of this industry due to its importance for human being, that's due to its role as protective product from weather changes during the year, and it indicates to the style of the wearers..

Keywords: Weave construction -double plain -lined weft -Thermal insulation - poly acrylic

1-INTRODUCTION:

Clothes are the transferable environment, or human first habitat, also known as human second skin, so the clothes should express the following dimensions and appearances:

- Physiological aspect, (that is clothes relevance to their function).
- Psychological aspect.(1)
- Cultural aspect: that is where clothes are worn for several purposes such as decency, protection, identity statement or self statement. (2)

The winter clothes protect wearers from cold temperatures, where the studies have proved the optimum temperature at which human body is the most thermally comfortable.

The aim the present work is studying the effect of some construction elements on the performance of winter clothes to achieve physiological comfort, liberty of movement and texture.

Research objectives could be summarized in the following three points:

- 1- Type of fabric that delivers the best functional performance when used for manufacturing male shirts .
- 2- Weave construction that is best for providing appropriate thermal isolation .
- 3- Weft threads density and its effect on the functional performance of fabrics being resea rched(3.)

Thermal insulation and its effect on thermal comfort :-

The humidity management and the ability for it to transfer through weave material contribute to the comfort feeling, when has been wearing the clothes made of that material.

Natural human activity cycle consist of work and rest , and the total of vital operation that provide energy for vital activity produce heat, this heat if increased would cause the body to try to decrease it through perspiring , that lead to humidity in the form of liquid next to skin, thus discomfort is due to the following reasons:

- The humidity next to skin.
- Less thermal insulation due to the accumulation of sweat and humidity in fabric pores.

Work clothes that are resistant to heat are usually worn in hot and humid conditions, for that reason materials with high capability of sweat and moist absorbance are highly recommended(4).

To increase the function of absorbing sweat and humidity there are several ways

The hydrophilic preparation of fabric surface .

The usage of a hybrid made of fabric thread and a hygroscopic material thread to produce the required fabric(3)

Keeping in knowledge that controlling fabric performance towards humidity is acheived through controlling complicated charactersitics such as absorption capacity , absorption rate , evaporation , and several others(5) .

Cotton fabrics gave the highest rate for residual water after applying vaborizing test on clothes made of them , also these fabrics gave the highest rate of cooling effect inspite the fact that they have highest humidity absorption capacity and rate .

Air is considered a bad conductor of heat , thus being considered a natural insulator , if the product is air provided it protects the wearer from cold and it retains body temprature . In order to use air as an insulator it should be trapped to stand still among fabric threads to provide the required thermal insulation such as in the case of wool (6).

Clothes usually retain air among its folds , but in hot weather the air is humidity saturated thus blocking the vaborizing process or allowing it only on the outer surface of the clothes .

The lesser the area the clothes cling to the body as a result for example to surface brushing , the lesser amount of temperature leaked there for inducing wormth.

Shine degree has an effect on body awarness of comfort , the shine degree of synthetic threads can be controlled generally by managing the cross section shape during weaving process. Despite that the regular circular shape of the cross section delivers a high degree of shine , but the threads tend to cling to skin upon touch which increase friction and in consequence discomfort for the wearer , for the lesser the proximity of clothes to the skin the more the comfort , there for there is a new trend to develope synthetic fibers with irregular cross section which results in less clinging and in the same time deliver the required shine and smoothness(7) .

Y.S Chen and J. Fan see that one of the important factors that affect thermal insulation , is garment fit or proper size . For thermal insulation and resistance to humidity evaporation increase when the aerial pockets between the body and the clothes are small(8) .

When these aerial pockets reach a confirmed value , thermal insulation and humidity evaporation resistance lessen with the increase in the aerial pockets thickness . Thermal insulation and humidity evaporation resistance reach its maximum when aerial pockets thickness reach a confirmed value , this value depends on fabric

properties , wind conditions , and garment fit , there for perfect fit is the most appropriate to retain body worm temperature in windy conditions .

Thermal resistance of fabric (thermal insulation) is a the resistance to heat flow and it is inversely proportional with heat conduct .

Fabric heat conduct does not depend only on surface area of threads composing the fabric , but it is also dependable on the area of the cross section of trapped aerial pockets in between threads , and both the threads and the trapped air have different heat conduct ability , for that reason fabric heat conduct depends on their volume ratio that is in woven fabric with single layer . But in the case of multi layered , fabric heat transfer rate in every single layer is equivalent to that of the other layers , so the sum of heat conduct resistance for multi layered fabrics is the sum of heat resistance for each layer(7) (8) .

Heat resistance of fabrics decrease with the increase in clothes dampness , when the person perspires the water fill in the space instead of air in the aerial pockets (10) .

For see that comfort feeling in clothes is connected to several factors , such as clothes light weight , their ability to transfer water vapor , as well as their ability to absorb sweat and to remain dry . For example winter sports wear should have the characteristic of water vapor transfer . Being comfortable while donning clothes made of layered fabric depends on the traits of every layer and on the way they are aligned together to form the fabric. The designer should pay attention to fibers choice , their nature , and their volume , as in designer choice of microfiber threads , that have unique characteristics. Designer should attend to hydrophilic and hydrophobic preparation of water resistant layered fabrics such as Gortex (9) .

Volkmar see that weather protective fabrics , also known as breathable fabrics , allow water vapor but does not allow water . Despite the fact that hydrophilic prepared fabrics have high level of relative humidity on their surface , but they have low resistance of water vapor(11) .

II PRACTICAL EXPERIMENTS AND LAB TESTS

Table (1) : Samples Parameters

NO.	Material type	Weave construction	pick / cm
1	Cotton	Twill 2/2	16
2			20
3			24
4		Atlas 4	16
5			20
6			24
7		double plain	16
8			20
9			24

10	polyester	lined weft	16
11			20
12			24
13		Twill 2/2	16
14			20
15			24
16		Atlas 4	16
17			20
18			24
19	polyester	double plain	16
20			20
21			24
22		lined weft	16
23			20
24			24
25	poly acrylic	Twill 2/2	16
26			20
27			24
28		Atlas 4	16
29			20
30			24
31		double plain	16
32			20
33			24
34	lined weft	16	
35		20	
36		24	

First stage / researched fabrics have been manufactured in a private textile factory

Constant factors involved in manufacturing research fabrics are :

- The number and type of used warp threads are 24/2 s cotton
- The density of weft threads in a single unit of measurement 22 threads /cm
- The weft thread number is 20/1 sand , its equivalent in other types of materials

Variable factors applied in samples production are :

- Type of used weft threads material (cotton - yarned polyester - poly acrylic)

- Weft densities(16 -20 - 24 pick/ cm)

- Four different types of weave constructions (Twill 2/2 - Atlas 4 - Plain Double - Lined Weft)

A table of fabric descriptions and sample numbers has been attached .Results and discussions :

III RESULTS AND DISCUSSIONS

Table (2) shows the results of tests

N0.	Material type	Weave construction	pick / cm	Tensile strength(n)	Elongation %	Fabric thickness.m	Thermal insulation.mk.m2.
1	cotton	Twill 2/2	16	256	12.4	58.8	8.4
2			20	352	14.4	62.2	11.46
3			24	411	15.4	64.83	14.2
4		Atlas 4	16	249	13.2	60.2	9.2
5			20	308	14.8	66.66	11.92
6			24	398	14.8	69.94	15.44
7		double plain	16	243	12	67.4	10.3
8			20	306	14	79.16	12.6
9			24	390	14.2	84.1	15.77
10		lined weft	16	236	11.8	77.6	11.35
11			20	298	13.9	95.44	15.54
12			24	372	13.9	97.1	16.92
13	polyester	Twill 2/2	16	877	20.8	54.6	9.44
14			20	1099	23.3	60.24	11.66
15			24	1114	24.7	62.83	14.9
16		Atlas 4	16	818	20.5	58.6	10.7
17			20	1078	23.1	61.1	13.7
18			24	1098	24.3	61.94	15.8
19		double plain	16	813	18.2	60.4	12.4
20			20	1067	21.3	68.7	15.32
21			24	1091	22.4	75.16	17.2
22		lined weft	16	804	17.4	64.7	12.85
23			20	1002	18.8	76.2	17.38
24			24	1079	22.1	86.66	20.4
25	poly acrylic	Twill 2/2	16	487	36.7	66.2	18.46
26			20	592	38.5	76.44	24.1
27			24	708	40.1	81.27	28.48

28		Atlas 4	16	444	36.2	70.4	19.66
29			20	580	37.8	80.72	25.2
30			24	694	40	84.55	29.4
31		double plain	16	432	34.9	81.2	21.4
32			20	562	37.4	95.82	25.6
33			24	680	39.4	98.33	29.9
34		lined weft	16	387	34	99.7	22.9
35			20	540	36.2	112.66	37.6
36			24	644	39.2	116.11	39.4

The following analysis has been made to study the influence of different research variables :

- 1- Material type : cotton , polyester , poly acrylic
- 2- Weave construction : Twill 2/2 , Atlas 4 , double plain , lined weft
- 3- Weft thread density : 16 , 20 , 24 pick / cm

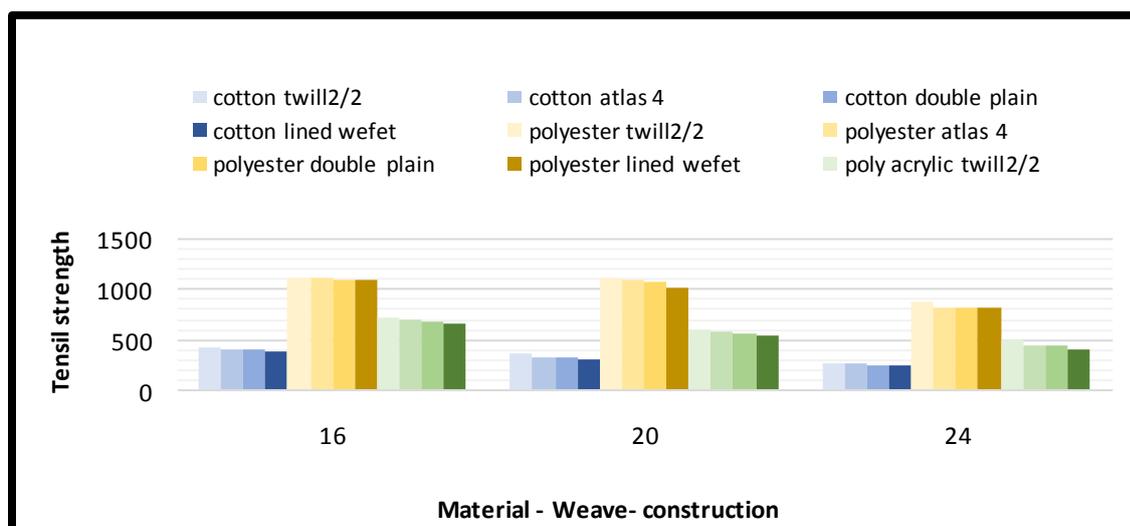
And the effect these variables have on measured characteristics (elongation in weft direction , cloth thickness , thermal insulation) in the produced fabric , keeping in notice that warp material is constant and so is the warp threads density which is 22 thread/cm .

After analyzing the results for Tests.

After accomplishing the research with required variables , and applying functional characteristics related tests for male winter shirts . The results have been listed in a table and so are the required statistics alongside studying the coefficient of correlation among research variables , as follows ;

3-2 Effect of fabric constructions on tensile strength:

Tensile has an important place among fabric characteristics that are used for making clothes , tensile is affected by several factors such as material type , weave construction , clothe weight



figure(1)Effect of various factors on the strength of fabrics

3-2-1- different material effect on sample tensile towards weft :

Table (2) and figure (1) illustrate each material type on produced samples tensile , for instance , polyester made materials gave results of highest tensile , that is due to the high ability polyester has for enduring tensile when compared with cotton and poly acrylic, thus the fabrics made of it.

3-2-2 Change in weave construction effect on tensile :

When all other factors are constant , and the only variable is weave construction in researched samples , fabric tensile increase , reaching its maximum with twill 2/2 , next to it Atlas 4 , then plain double and finally lined weft .

3-2-3 Pick / cm effect on tensile :

Table (2) figure (1) show weft density effect on fabric tensile , where there is a direct correlation between weft number increase and tensile , that is because a larger number of weft threads share the load of tensile the samples subjected to it .(12)

3-3- Percentage of fabric elongation in weft direction :

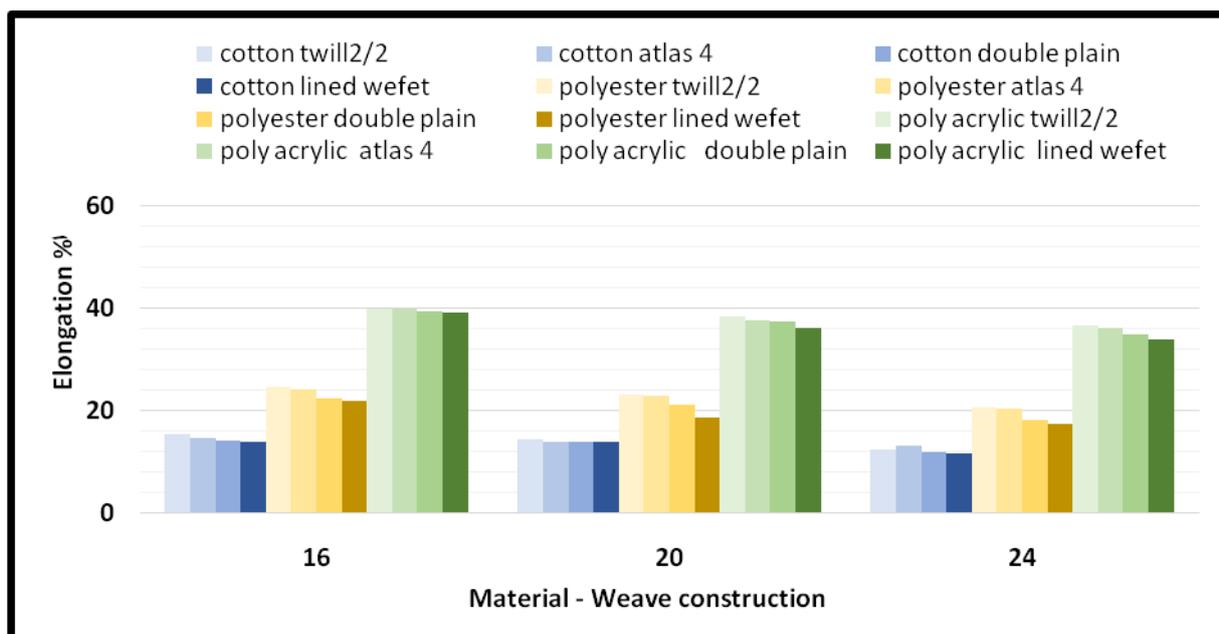


figure. (2):Effect of various factors on the elongation

3-3-1 material variation effect on elongation in the direction of weft :

Table (2) figure (2) show the effect of material type in the direction of weft on elongationpercentage . Poly acrylic gave the highest elongation percentage , next came polyester then cotton made wefts , that is due to the nature of these threads.

3-3-2 weave construction variation effect on elongation :

Table (2) figure (2) illustrate the strong connection between weave construction and elongation percentage , where the weave construction twill 2/2 gave the highest percentage of elongation , next comes Atlas 4 then plain

double and finally weft lined , that is because when the overlappings in the weave construction increase the number of overlappings decrease in single measuring unit so is the elongation percentage(13)

3-3-3 The effect of varying weft density on elongation :

Table (2) and figure (2) illustrates the strong connection between the number of wefts per centimeter and elongation percentage . The increase in weft density per centimeter results in the increase in the number of overlappings in single measuring unit , which strengthens the ties between threads and wefts , and increasing the elongation percentage as a result

3-4- Fabric thickness :

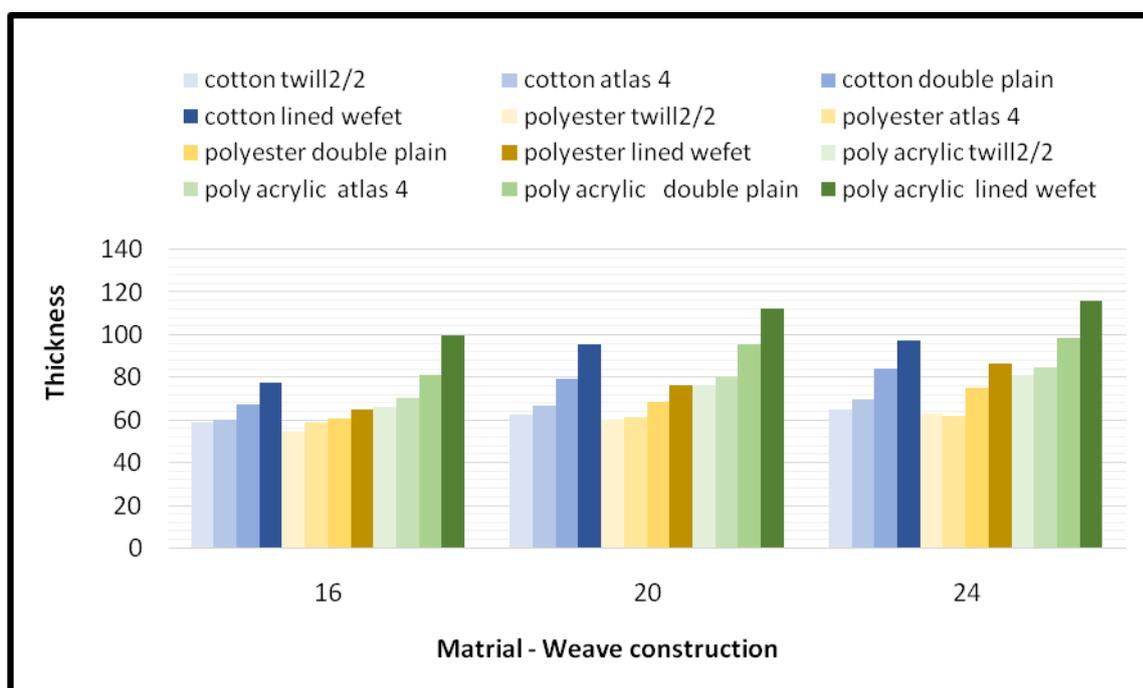


figure. (3): Effect of various factors on the thickness

Fabric thickness has a direct impact on the different characteristics of the cloth ,specially on thermal insulation (feeling warm)

3-4-1 Effect of different materials on fabric thickness:

Table (2) and figure (3) illustrate different material types effects on thickness , samples with poly acrylic wefts have the thickest form , next comes polyester , then samples with cotton wefts . That is due to the poly acrylic nature , that is being huge and occupies a great part of space , with a thickness more than other materials.(12)

3-4-2 Change in weave construction effect on fabric thickness :

Table (2) and figure (3) show the effect of different weave constructions on fabric thickness , where thickness varied in twill 2/2 , Atlas , Double , and lined , despite the constant material type and constant density . It was found that weft lined construction achieved the highest thickness , Double came next , then Atlas , and Twill 2/2 came last. The nature of both the Double and the Lined weft allow the threads to slide forming what looks like

two layers of fabrics the thing that gives the fabric a thicker consistency than that of Twill2/2 and Atlas 4. **3-4-3**

Different weft densities and its effect on fabric thickness :

Table (2) and figure (3) illustrate the relation between the increase in weft number per centimeter , and fabric thickness , with other factors remaining constant . There is a direct correlation between weft numbers and fabric thickness , that due to the following :

When weft number increase per centimeter , the number of overlappings increase in turn , where every overlapping introducing a salience over the fabric surface , which increase the thickness .(14)

When the overlappings number per centimeter increase the percentage of Chips stored inside the threads increase and so does the thickness.

3-5- Thermal insulation of fabrics :

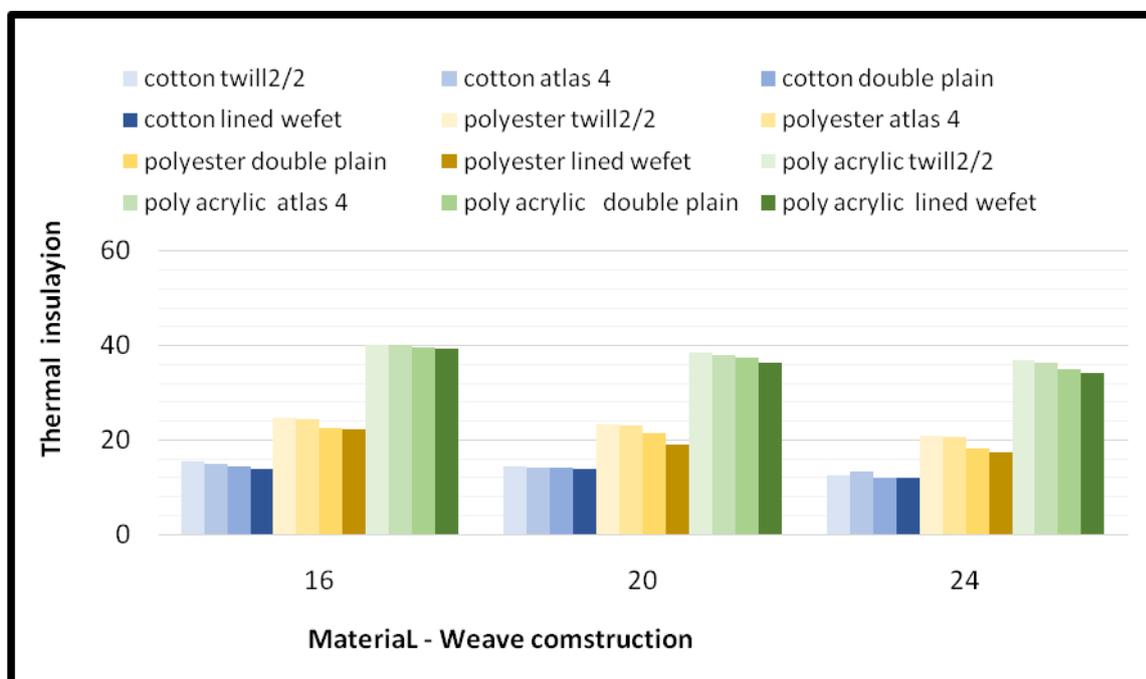


figure. (4):Effect of various factors on the Thermal insulation

Fabric capability of thermal insulation is defined by several factors , such as material type , weave construction , square meter weight.

3-5-1- The change in material and its effect on thermal insulation :

Table (2)figure (4) show the extent of the effect material type has on thermal insulation . Fabrics made of poly acrylic scored the highest ability of thermal insulation , polyester made wefts came next and cotton made wefts came last . That is because of the poly acrylic ability to lock still air inside thread anatomy , increasing their ability on thermal insulation .

3-5-2- Change in weave construction and its effect on thermal insulation :



Table (2) figure (4) , illustrate the effect of weave construction applied , on the thermal insulation of fabric when all other fabrics are constant . Lined weft weave construction achieved the highest rate of thermal insulation , due to its ability of trapping air inside it which inhibits temperature leakage to and from the body . Double plain construction comes second , then Atlas and finally Twill 2/2 .(15)

3-5-3 Change in density and its effect on thermal insulation :

Table (2) and figure (4) show the direct correlation between weft number per centimeter and thermal insulation ,when all other factors are fixed . That due to increase in thread merging and thus the ability to trap air inside it which lessen heat leakage through fabric.

IV RESEARCH SUMMARY

Product quality depends primarily on how suitable its basic characteristics to the requirement of its usage , and how befitting it is to the function it was intended for , this function that is defined through careful study .

Designing and manufacturing clothes with specific purpose , like winter male shirts , depending during that on a scientific basis to determine fabric characteristics , help to define the correct weave construction for these fabrics .

This research aims at producing fabrics that provide the required comfort alongside providing thermal insulation that suits their purpose as winter male shirts.

Within that frame , 36 samples have been produced using a single type of warp threads (cotton 24/2) , and a single type of warp density (22threads /cm) , and applying 3 different weft materials , these are cotton , polyester , and poly acrylic of number 20/1 or its equivalents .

Four different weave constructions for each material have been used , these are Twill2/2 , Atlas 4 , Double plain , and weft line. With each weave construction 3 types of pickes have been applied , these are 16 , 20 , and 24 pick / cm . After the samples been produced , proper functional performance tests for winter fabrics have been applied on them. These are tensile , elongation , fabric thickness , and thermal insulation .

The study has proved that there is a direct influence to material type , weave construction , and pick number per centimeter , on the functional performance of the samples. Where samples with poly acrylic wefts gave the best results in achieving thermal insulation and thickness , making them the best candidate , after wool , for making winter fabrics , and the samples with polyester made wefts achieved best results in the field of tensile.

Considering the world wide development of weave and textile industry , where a diversity of manufacturing processes and machinery are applied . And with the many assortments of materials that result in different fabrics , this research aimed at studying the different possibilities in producing winter male shirts fabrics . That is because of the change that came over the used materials and weave constructions. With the increasing prices of natural wool material , which was essential to manufacturing winter clothes , it became necessary to study substitute weave constructions that would provide warmth and proper comfort for the consumer , and would deliver financial and practical content. This research presented several weave constructions , and three different materials (cotton , polyester , and poly acrylic) with different densities .

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