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DESIGN COMFORT INSULATION ABILITIES OF CRINKLES CLOTHES FOR EUROPE ENVIRONMENT

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Crinkles woven fabrics and thermal insulators proposed for method were presented and described in the form of crinkles woven fabrics in many industrial applications. The thermal insulating properties of textile fabrics depend on the thermal conductivity, density, thickness and thermal emission characteristics. The experiments carried out aimed at studying the heat transfer by conduction through the different types of fabrics used as thermal insulators. 100% of warp cotton, and several kind of wefts (Polyester, cotton, viscose rayon, fibran, blended" cotton/Polyester" and Lycra) as fabrics are used in this work as case study. Analytical methods (for example ISO 7933) for the assessment of the crinkles woven fabrics and thermal strain caused by several exposures to hot environments require a mathematical quantification of the thermal properties of clothing. The thermal response and behavior for the selected the crinkles woven fabrics that used in this work as thermal insulators are illustrated. The relationship between the thermal conductivity and material density and crinkles fabric structure. Were selected fabrics is studied. These elects are usually considered in terms of dry thermal insulation and vapour resistance. This simple `model' of the crinkles woven clothing can account for the insulation properties of clothing which reduce heat loss between the body and the environment and, the transfer of evaporated sweat from the skin, which is important for cooling the body in Europe environment. When a clothed person is exposed to the crinkles woven fabrics, however, and when the person is active, there is a potentially significant limitation in the simple model of the crinkles woven clothing presented above. Thickness with fibran fabric has higher thermal resistance and specific heat resistance than polyester and viscose. Fabric thickness has significance effect on the fabric temperature variations. The results of A NOVA-two way are presented for spider structure 100% of polyester and square structure 100% cotton/polyester (50/50) fabrics. The temperature variation of the fabric increased with test time and also, decreased with increasing of fabric weight up to certain limit beyond its optimum level. The results show that the selected cotton/polyester fabrics are suitable for usage as thermal insulators. Heat and mass transfer can take place between the microclimate (within the crinkles woven clothing and next to the skin surface) and the external environment. The lee's method described in this paper and static value of clothing properties to provide dynamic values that takes account of the crinkles woven fabrics and weft materials. It therefore allows a more complete representation of the elects of clothing on the heat strain of Pupil's.

Keywords: crinkles woven fabrics, Heat transfer, and Thermal insulator.

1. Introduction

A low temperature environment poses a significant risk to the human body in terms of comfort, performance and health. Clothing items for cold protection should provide the necessary thermo physiological comfort by playing the role of a protective barrier between the body and the environment [1, 26, 2]. Crinkles in woven fabric as wrinkled from being a part of potential aesthetic interest to the fashion or mass-market garment industry [12]. The wearing of clothing during school in the heat will have major elects on the thermal strain of pupil’s. If the sitting room is hard and the clothing is heavy, then serious elects on health can occur in what may ordinarily be considered to be moderate environments [26]. If environments are hot then the sitting room is potentially dangerous. To predict the extent of the thermal strain on pupils and whether it will be acceptable, to development applications for the new shading materials need to be chosen with care. Innovative approach to this problem is to use selected combinations of shading device configurations fabrics, yarn and fiber structure, as well as finishes [37]. Such as crinkles woven fabrics used as thermal insulators require a full study of its thermal insulating properties at different operating conditions [11]. Then depending on clothing design and type, crinkles clothes saturated is warm air will be forced through vents and the clothing layers. If there is wind then this will also affect the exchange of air between the microclimate within clothing and the outside environment. Traditional methods for the assessment of heat stress rarely take these important factors into account[9]. Any risk assessment must consider the influence of clothing and must therefore take a view on the thermal properties and elects of the clothing. A simple approach would be to judge the likely elects from minimally clothed/very light clothing, where the pupils would be free to evaporate sweat and lose heat to the environment, to heavy and impermeable clothing which will restrict the evaporation of sweat and hence cause the body to `heat up' rapidly in a hot environment. One of the most important of these studies is the effect of temperature with thermal conductivity and material density on the response of the textile fabrics as insulators. Thermo insulating properties of perpendicular -laid versus cross-laid lofty non-woven fabrics are presented by Oldrich et al [36]. In their study, the relationship between the thermal conductivity and material density of samples was studied. Based on the previous investigations [8]. it was postulated a theoretical analysis according to the physical properties of the fabric and the physical activities of the toddler considering the several of density by denting systems and materials transfer through the toddler clothing. They concluded that the thermal conductivity decreases with increasing material density. Morris [34]. Presented a study of thermal properties of crinkles woven fabrics and concluded that their thermal conductivity increases with density, based on his observation that when two fabrics are of equal thickness, the one with a lower density has the greater thermal insulation. The Activity Level on Thermal Comfort Activity level has the largest effect on thermal comfort. To measure how much heat is generated by a body for different activity levels, metabolic rate measurements can be performed. Metabolic rate increases in proportion to exercise intensity. By ASHRAE definition[5], the metabolic rate is the rate of energy production of the body and is expressed in met units. One met is defined as 58.2 W/m2 (the energy produced per unit surface area of a seated person). McNall et al. (1967) [33]. Tested several metabolic rates and found little humidity effects at low metabolic rates and increased humidity effects at higher metabolic rates. Also, sweating and an increase in skin temperature occur when metabolism is increased. The background to the approach is presented in Havenith et al(1999)[20]; HolmeÂ r et al.(1999)[25] in this special issue. Data from stationary and moving human subjects and manikins were used to derive a general correction to `static' insulation values based upon empirical analysis. Where clothing is worn the heat and vapour (evaporated sweat) transfer properties of the clothing will be important. What is really meant by clothing as a covering over the body needs to be considered. Different types of clothing items are worn on head, neck, and hands, on feet other than on the torso. Clothing often is rather similar on torso, arms and legs where the dimensions of these cylinders are different. Development in clothing has tended to be about 80% of the body area, called (body clothing). The suspended clothes from the head in much the same way that a poncho or cap is suspended from the shoulders. If the Torso protected by a draped cylinder or shell suspended from the head, and not at close contact with the neck, there would be wonderful opportunities for controllable ventilation even without body motion by chimney effect. A simple estimate of these properties can be obtained from tables of deferent clothing garments and ensembles (for example ISO 9920(1995) [28]. Every point of close contact of clothing with body whether at collar, on the shoulders, by belt at the waist, or by snug cuffs at elbows and ankles, reduces the possibility of convection or chimney flow. Hong &Hollies [27] reported that at inner fabric surface, the sweat by skin built up low moisture vapor concentration with cotton fabric, but cotton/polyester conducted a highest rat of concentration. Moreover garment belted at the waist and a skirt permits more airflow than trousers. Air by body motions will increase the internal circulation as well as reducing the external airflow. Neck protection can come from collar turned up from the shoulders (which is looser and larger would approach the idea of hood) or by separate tippet or muffler. Also of great significance however are the ventilation properties of the clothing and how the thermal properties are elected by the Pupil’s' activity and environment. However, he reported that there is a critical density of about 60.0 kg/m3, below which the convection effects become dominant and the thermal insulation falls.

Recently, the heat flux sensor was used to measure the thermo-insulating properties of textiles in an apparatus called the Alambeta [22]. The thermal properties of fabric insulators are investigated by Ukponmwan [44]. Heat and mass transfer analysis of textile fabrics are presented in many researches [38-31]. In these researches, the effect of operating parameters such as temperature, humidity and heat & mass transfer coefficients are examined by mathematical and experimental studies. A model of heat and water transfer through layered fabrics was developed by Fohr et al [16]. The relative humidity range is important not only for comfort, but also for health issues. An increase in relative humidity encourages mildew growth, but low relative humidity can result in respiratory problems due to dryness. The bacterial populations typically increase below 30% and above 60% relative humidity. Relative humidity below 40 % may cause respiratory infections. High relative humidity causes chemical reactions to occur. Conversely, low relative humidity produces ozone that irritates the mucous membranes and eyes. There are four environmental parameters and two personal parameters that influence thermal comfort. In order to determine how these six parameters affect the human comfort, thermal sensation scales were established. Fanger (1970) [14] developed the Predicted Percentage of Dissatisfied (PPD), a method used to estimate unacceptable conditions for occupants. Based on the PPD method, if 95% of the occupants are satisfied then the environment is classified as comfortable. However, PPD is based on the Predicted Mean Vote (PMV), which is used to predict an occupant’s thermal sensation based on the environmental parameters. If there are the crinkles woven fabrics then this will also elect the exchange of air between the microclimate within clothing and the outside environment. Traditional methods for the assessment of heat stress rarely take these important factors into account. This paper presents a method for incorporating the elects of the crinkles woven fabrics and human movement into an estimate of the thermal properties of clothing such that it can improve heat stress assessment methods. Compression and thermal properties of recycled fiber assemblies made from industrial waste of seawater products are presented by Sukigara et al [40]. In their study, the effective thermal conductivity of fiber assemblies with the steady- state, and parallel-plates was measured. Their results showed the lower effective thermal conductivity of recycled fiber assemblies than pure wool fiber assemblies, these indicate that the effect of heat radiation on thermal conductivity cannot be ignored. In this work, the heat transfer through two different fabrics; warp of 100% and several weft with several of fabric structures were studied. The experiments are carried out using a special test-rig to study the thermal behavior of the selected crinkles woven fabrics used as thermal insulators in many applications. Temperature, density, thickness and weight are measured for the selected crinkles woven fabrics used as case study [11]. The thermal insulation properties of the selected textile fabrics are calculated and studied with respect to the importance of operating conditions such as; inlet temperature, thickness, weight and density [10]. The comparison between the selected crinkles woven fabrics as thermal insulators according to certain operating conditions is given. On the basis of this study, some applications of these materials are considered. They aimed at studying the effect of weather conditions and human activities on the selection of clothing. Their model takes into account the occurrence of condensation or evaporation in accordance with the environmental conditions and their variations [15]. Thermal expansion behavior of hot-compacted woven of cotton 100 % and several wefts with several of fabric structures as the flowing:

1 – The true relationship between kinds of materials wear applied for warp and weft measurements and thermal properties of the crinkles woven clothing, be it measured or predicted by existing models, has not been systematically proved specifically for clothing for subzero conditions,

2 – The true relationship between the type of woven construction and thermal properties of the clothing,

3 – The true relationship between -type crinkles woven fabrics by arranging warp and weft wear applied for warp and weft Measurements and thermal properties of the clothing,

4 – The true relationship between thickness & weight of clothes the crinkles woven fabrics Measurements and thermal properties of the clothing.

5 – Product light weight of crinkles woven fabric has thickness with thermal properties of the clothing.

6 – The relationship between measured thermal insulation values of cold protective clothing and the corresponding physiological reactions on human test subjects,

7 – The influence of the crinkles woven fabrics evaporation and condensation on the heat transmission properties.

8 – Developing a psychological comfort model of the crinkles woven fabrics that accounts for the variability in human perception of crinkles woven fabrics comfort based on age group, gender, and social level. (Primary school). We have been investigating the influence of environmental factors on human physiological responses and comfort.

9 – The use of clothing materials (the crinkles woven fabrics) that might increase the thermal and reduce load placed on participants/pupils was evaluated.

10 – We will emphasize the physiological measure of core temperature as it dictates none’s ability to perform walk in a hot/humid environment and directly influences a participant’ sensation of comfort. Other measures (heart rate, mean skin temperature, rating of perceived exertion, skin comfort, clothing comfort) have been determined but are not presented.

2. Experimental work

In order to investigate the heat transfer and thermal behavior of crinkles woven fabrics as thermal Insulators, especially experimental testing was designed and constructed to measure the temperature variation with test time through the selected crinkles woven fabrics during the heat exchange process between the inlet hot air and the crinkles woven fabrics sample. Experiments are carried out on two group of fabrics structure. The crinkles woven fabrics samples are The fabrics designed formation technique and produced on the

Picanol weaving machine attachment with head of jacard in Eldelta spinning and weaving – Tanta and (Zifta factory) company-Egypt, and The fabrics tested in consolidation fund at Alexandria, faculty of science, Tanta university, and faculty of engineering Elmansura university, According to A.S.T.M, standard, A group of samples made from polyester, fibran, rayon viscose, blended, cotton and lycra fibers without arranging of weft, but with different weight per unit area, another group made from same weft but with arranging 14 of weft from polyester, fibran, rayon viscose, blended (cotton/polyester (50/50)), cotton, and 14 of weft from lycra, with the with different weight per unit area weight. The fabric samples are subjected and exposed to different levels of heat in the emission side (the heat source side) and then the temperature are measured in the other side of the fabric sample in order to evaluate its thermal resistance and behavior as thermal insulator.

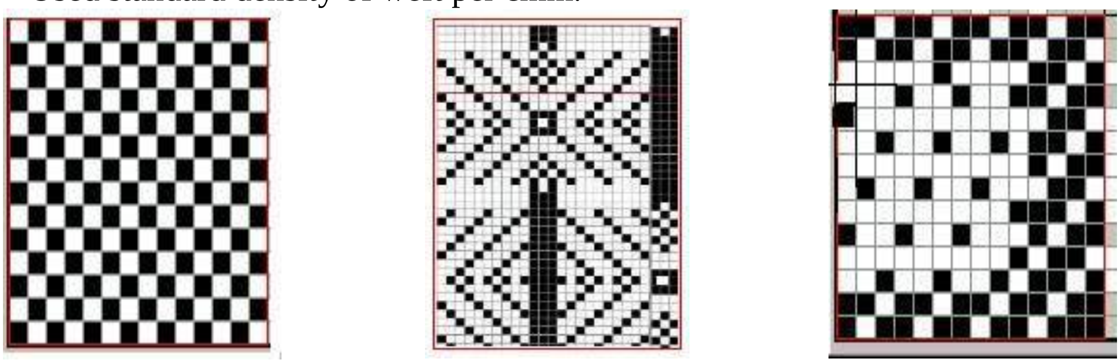
2.1. Analysis of Thermal Comfort Modeling

Warp of Fabrics (100% cotton of rang spinning) were constructed with variations in crinkles woven fabrics construction types and yarn size. The woven fabric construction types were (plain weave 1/1, spider weave, and squared weave) illustrated in Figure 1 (A, B,C.) Yarn of warp sizes were 30 Tex of cotton, and weft wear (37.5 Tex of cotton, 40 Tex of fibran, 40 Tex of viscose rayon, 25 Tex of blended (cotton/polyester (50/50)), 40 Tex of polyester and 33.86 Tex of Lycra (see Table 1). The crinkles woven fabrics are being fully characterized for those properties that may relate to comfort when used for apparel. Correlations with structure variables will be determined. Initial testing includes radiation studies (thermal and crinkles fabrics) and thickness measures. Tests that are nondestructive and that do not alter the fabrics are being conducted first.

Table 1 – Describe of fabric specification

Woven type	Density of yarn /cmm	yarn linear density	Type of weft					
		Cotton	Cotton	Fibran	Viscose	Blended	Polyester	Lycra
		Tex	Tex	Tex	Tex	Tex	Tex	Tex
plain weave 1/1	27x22	30	37.5	40	40	25	40	33.86
spider weave			37.5	40	40	25	40	33.86
Squired			37.5	40	40	25	40	33.86

Used standard density of weft per cmm.



a b c

Fig. 1. The type of fabric structure

2.2. Properties` Evaluation

2.2.1 Weight by geometry method [12].

Testing, Sampling, marking out, by find the diameters of warp and weft cross section, according to Grosbarg) . In the following equation:

$$d = 4.44 \left(\sqrt{\text{Tex count} / \text{fiber density}}\right) 10^{-3} \text{ cm.} \quad \ldots (1)$$

Where: d1, d2 = diameter of warp -weft cross section.

To find the (weight) of warp or weft by the following equation:

$$W = \pi (d^2/4)\, L * \text{number of warp or (weft) threads in cloth} = \text{gram.} \quad (2)$$

The 33 samples with the three models of fabrics structure with several weft (cotton, polyester, fibran, blended (cotton/ polyester (50/50)), and viscous rayon) with Lycra.

2.2.1. Weight per Unit Area

Testing, Sampling, marking out, cutting, accuracy of weight and moisture content must be all considered. After cutting by a standard template, the 33 samples with the three models of crinkles woven fabrics structure with several weft (cotton, polyester, fibran, blended (cotton/ polyester (50/50)), and viscous rayon) with Lycra. Have been weight according to the standard atmosphere according to ASTM [6]. With aid of an electronic balance, with accuracy 0.001g the mean values of weight have been obtained for each of the crinkles woven fabrics where considered as moisture fabric.

2.2.2. Evaluation the Thickness of Clothing

Gibson [19] have recognized the crinkles woven fabrics thickness as a prime factor in determining the level of effective comfort properties such as insulation, water vapor transmission and water maximum holding capacity or moisture content. The measurement of thickness of crinkles woven fabrics has been carried out according to the A.S.T.M [6, 7]. For the determination of the thickness of a compressible material such as crinkles woven fabrics, it is essentially that the test consists of precise measurement of the distance of the two plan parallel plats of the device when the cloth separates them. A known arbitrary pressure between the plates being applied and maintained. At the standard condition the mean obtained values are reported to the nearest 1% accuracy .The values showed that the crinkles woven fabrics thickness of the blended Fabric is thicker than the cotton fabric. Lyman [30] and several investigators for the variation of the crinkles woven fabrics insulation with thickness indicated that the insulation values are from 1 to 1.6 Clo/cm. Two major reasons for these results are: Firstly, thickness of fabric is measured under a pressure higher than pressure is applied at the crinkles woven fabrics are being worn. Secondly, the air spaces in clothing between the worn layers could reach a thickness of 5mm. This result could indicate the insulation of clothing crinkles woven fabrics and is due to the air trapped in between Hearl [21,7] stated that the resistance (conductivity) of the crinkles woven fabrics materials varies considerably with their moisture content .In generally, the increase in the amount of sodium and potassium salts present in cotton clothes was associated with resistance reduction or (conductivity) [42].

2.2.3. Evaluation the Air Permeability:

An air permeability of crinkles woven fabrics materials is possible to characterise as their ability to transmit air under given conditions. Under laboratory conditions the air permeability is standard evaluated according to EN ISO 9237 that defines air permeability as a velocity of airflow through the sample of crinkles woven fabrics at the specified conditions for a sample area, a pressure difference and the time. In order to point out crinkles woven fabrics characteristic from which thermal insulation may be estimated most accurate, thickness and volume of air per unit area of fabric have been considered Anne & Mary [32,3] have found that a linear relationship exists between thermal insulation and thickness of crinkles woven fabrics for both single and multiple yarns that thermal resistance of apparel crinkles woven fabrics of dry fabric or one containing very small amount of water depends on its thickness, whilst a lesser extent on fabric construction and fiber conductivity[42]. Mary& Morise [32] have found a highly correlated relationship with the thermal insulation when the air permeability α ($m^3/sec.m^2$) was measured with a different way. On the other hand the Take-Uchi theory and George [18,43] might explain the mechanism of heat transfer where it depends on the physical fabric characteristic as permeability and thickness of crinkles woven fabrics. To study the factors involved in clothed of the uniform heat transfer, it was necessary, therefore, to measure the air permeability of each construction. The samples have been tested under the Standard ASTM test [6].

2.2.4. Evaluation the Water and Moisture Regains:

The term wettability in general, one could say that the time factor is involved. Farnsworth & Rodwell& Rebourn and Ashrae [28, 29, 30] as many textile researchers have attempted to find the material factors that explain subjective sensation of comfort and discomfort. Measurements of fabric permeability properties that are related to actual wearing condition have not been established. Most studies have been concerned with liquid water transport, such as wicking, rather than water vapor transfer. Moisture regain and equilibrium vapor diffusion through crinkles woven fabrics do not predict comfort rating by human subject, where still other parameters such air permeability, fabric weight, structure and design of crinkles woven fabrics… etc [39]do not include the conformability subject. For testing fabric absorption, the equipment and methodology in this study are described in reference [17].The measurements are reported. Before testing, it is normally involving fabrics pre-conditioned to a standard atmosphere to equilibrate specimens to an atmosphere of 20˚C and 65% R.H. The spacemen were immersed on a dish of water for five minutes [23] at 20˚C and be put freely on an inclined surface for the same time. By the way, the mean values of fabric weight have been obtained for each of the dry fabric, moist fabric and fully wet fabric (the maximum holding water). The relation between the thicknesses of crinkles woven fabrics and weight however could be correlated as a function of the specific volume

2.2.5. Calculation the thermal conductivity

The lee's disc method for the thermal conductivity of bad conductor Apparatus: the simple form of lees` disc apparatus to be found most laboratories , The upper half of the apparatus is metal steam chest AB and the lower is a cylindrical disc of metal (cooper or brass and of known specific heat capacity) of the same diameter. Between them as a thin circular slab of the bad conductor (e.g. cork, cardboard, glass, and ebonite) cut to the same diameter as the two halves of the main apparatus. The whole is suspended from a heavy stand and clamps by non-conducting strings attached to the lower metal slab. Also required are a steam heater, rubber, tubing two thermometers 0-100 0c in 0.2 0c, asbestos screens, stop-watch, glycerine, calipers, micrometer gauge (Armitage) [4]. Assume that the system of the toddler in the class room is spatially steady state temperature and moisture or liquid water concentration does not change with time the thermal toddler bodies maintain its thermal equilibrium with the environment by means of three modes of heat transfer Assume that heat is produced by metabolism Qm., by other way Qm – Heat dissipated to the atmosphere due to the metabolic heat production and the useful rate of working [42, 35],

$$Q_m = Q_E \pm Q_R \pm Q_C \pm Q_{Cd} \quad (3)$$

Q_E – Heat transfer by Evaporation

Q_R – Heat transfer or gained by radiation and Q_C – Heat transfer gained by convection;

Q_{Cd} – heat transfer by conduction.

The conductivity equation for the steady state is [4]:

$$Rate\ of\ \ flow\ of\ \ heat = \lambda\ X\ area\ of\ \ cross\text{ - }section\ X\ temperature\ gradient \quad (4)$$

Hence, for the badly conducting specimen,

$$Area\ of\ \ cross\text{ - }section = \frac{1}{4}\pi D^2 \quad (5)$$

And, if we neglect the small amount of heat lost from its curved surface of crinkles woven fabrics

$$temperature\ gradient = \frac{ø_1 - ø_2}{d} \tag{6}$$

Now, when the steady state has been attained, the rate of flow of heat through the bad conductor is to the rate at which heat is emitted from the lower metal disc. Assuming that heat lost conduction through the bed conductor in the dynamical part of the experiment is negligible this can be obtained from the cooling curve [4]. If we assume the Newton's law of cooling applies the statical part of this experiment, namely, that the rate of loss of heat from the metal disc is proportion to the temperature difference between the body and its surrounding by crinkles woven fabrics, then equation (5) above may be written

$$constant X(ø_2 - ø_o = \lambda X \frac{1}{4} \pi D^2 X \frac{ø_1 - ø_2}{d} \tag{7}$$

where $ø_0$ is the mean laboratory temperature, if another badly conducting specimen of thickness of crinkles woven fabrics d' and thermal conductivity λ' is substituted for first specimen and $ø'_1$ and $ø'_2$ are the resulting mean steady temperatures, then $constant X(ø_2 - ø_o = \lambda' X \frac{1}{4} \pi D^2 X \frac{ø'_1 - ø'_2}{d'}$ and by division of (5) and (6):

$$\frac{(ø_1 - ø_2)}{(ø'_2 - ø_0)} = \frac{\lambda}{\lambda'} X \frac{(ø_1 - ø_2)}{(ø'_1 - ø'_2)} X \frac{d'}{d} \tag{8}$$

An equation which enables the comparison $\left(\frac{\lambda}{\lambda'}\right)$ of the two thermal conductivities to be obtained from the stoical part of the experiment alone [4]. The heat energy can be transferred through the crinkles woven fabrics by conduction, convection and radiation that easily explainable phenomena such a sheet exchange in porous media. Basic concepts of the heat transfer through crinkles woven fabrics are explained as follows:

2.3.6. Thermal Conductivity

The heat transfer by conduction depends on their heat conductivity[36], i.e. their capacity of transferring heat from a warmer medium to a cooler one. The main characteristics of heat conductivity are: Conductivity factor λ [W/(m^2 ^{o}C)] expresses the heat flow (Q), W, passing in 1 h through area (A) of 1 m^2 of the fabric thickness of crinkles woven fabrics (L) at a temperature difference (T1 – T2) of 1 ^{o}C, as given in the following equation [40]:

$$\gamma = QL/At(T_1 - T_2) \tag{9}$$

Heat transfer coefficient K [W/m^2 ^{o}C] expresses the heat flow passing during 1 h through 1 m^2 of fabric with actual thickness of crinkles woven fabrics, (L) and difference temperatures of two media (air and fabric) 1 ^{o}C, as the following equation[42].

$$K = Q/At(T_1 - T_2) \tag{10}$$

Thermal resistance of mixture fibers and air is approximately equivalent to the thermal resistance derived from layer of still air of the same thickness of crinkles woven fabrics less an amount due to the heat conduction in the fibers present. The packing factor of the material and the fiber thermal conductivity should be considered.

From equation of packing factor

$$\lambda = \frac{M}{t \rho_f} \tag{11}$$

here ρ_f – Fiber density.

Generally the density of the cotton fiber is equal to 1450 kg/m^3 where the polyester fiber is 1380 kg / m^3 and the blended (50/50) suppose to be the average of the two materials i.e. 1415 kg / m^3 Sultan [41]. Also emphasized that the garment is greatly influenced by the fabric setting (warp &weft) and its air permeability in crinkles woven fabrics with highly consideration of the synthetic fabrics. Because of the fabric weight and setting are known, the approximated cover factor C [29].might be considered where a function of the fabric setting is:

$$C^2 = 1.36M(N_1 + N_2) \tag{12}$$

Then the weight will be

$$M = \frac{0.7347C^2}{(N_1 + N_2)} = \frac{5}{4}\pi t^2 (L_G + Ls)\rho_G \tag{13}$$

where thickness will be

$$t = \left| \frac{0.293C^2}{(L_G + Ls)\rho_G (N_1 + N_2)} \right|^{\frac{1}{2}} \tag{14}$$

2.3.1. Specific heat resistance, (r)

The specific heat resistance, r (m^2 ^{o}C) /W) is a characteristic inverse to the heat transfer factor, λ as the following equation:

$$r = 1/\lambda = At(T_1 - T_2) - (QL) \tag{15}$$

2.3.2. Heat resistance, (R)

The heat resistance, R (m^2 ^{o}C / W) is a characteristic inverse to heat transfer coefficient, K as the following equation [40]:

$$\mathrm{R} = 1/K = A\mathrm{t}(\mathrm{T}_1 - \mathrm{T}_2)/(Q) \tag{16}$$

The specific heat resistance, ρr and the heat resistance, R characterize the heat capacity of the fabrics to impede the transfer of heat through them.

2.3.3 Thermal resistance, (Rth)

Rth, of textile fabrics is a function of the actual thickness of crinkles woven fabrics material and the thermal conductivity, K. This function is given by the following relationship:

$$R_{th} = L/K, (m^{2\,o}c)/w \tag{17}$$

where L is the actual thickness of the sample, m.

2.3.4. Heat flow, (Q)

The heat flow, Q, through the textile fabric is given as the following [40]:

$$Q = -KA/(T_1 - T_2)/L \tag{18}$$

where A is surface area of crinkles woven fabrics exposed to the hot air, T1 is the initial air temperature and T2 is the transient air temperature. The textile fabrics have two thermal functions; they prevent air movement and provide a shield against radiant-heat losses. Within the limit before heat conducted by fibers becomes dominant, the more densely fibers are arranged within the fabrics, the better that they will fulfill these two functions.

2.4. Value of Energy [37]

The value of energy for textile fabric is simply the transient heat conduction equation with a heat radiation source term; this equation is given as [40]:

$$K = \frac{\sigma^2 T}{\sigma X^2} = Pc_p \frac{\sigma T}{\sigma t} + \frac{\sigma q_r}{\sigma X} \quad (19)$$

where k, ρ, CP, T and t are the thermal conductivity, density of crinkles woven fabrics which it was calculated as ρ= ω/L (ω is the basic weight of the sample), specific heat, temperature and time for the

$$0 \le X \le L, 0 \le t \le \infty \quad (8)$$

where, L is fabric thickness of crinkles woven fabrics. qr is the heat flux by radiation at any point within the fabric and can be written as, [24]:

$$qr\,(x) = 4\,\partial T_o^{\,3}(T_1 - T_2\ )at0 \subseteq X \subseteq L \quad (20)$$

where ∂ is the Stephan-Boltznan constant and equals 5.67x10^{-8} W/m^{2}K^4 and To is the mean temperature in our experimental (To = 298 K).

2.5. Value of Thermal Insulating [44]

Value of Thermal Insulating represents the efficiency of the crinkles woven fabrics as an insulator. It is defined as the percentage reduction in heat loss from a hot surface maintained at a given temperature. The value of thermal insulating in crinkles woven fabrics increases to 100 % when a "perfect" insulator is obtained. Value of thermal insulating of crinkles woven fabrics depends upon the thermal conductivity of the fabric, the thickness of the assembly and the thermal emission characteristics of the surface crinkles woven fabrics. It is expressed as a percentage, which represents the reduction in the rate of heat loss due to the insulation, relative to the heat loss from the surface. Thus, the following relation represents this value:

$$(VTI)\% = 100[1\text{-}(Kt/\varepsilon o)/(L + (Kt/\varepsilon 1)] \quad (21)$$

where εo and ε1 are emissivity of one surface of the insulator (crinkles woven fabrics) and the other surface, respectively. A typical value of emissivity of textile fabric is 2.06 cal. / m^2 s ^{o}C. The conversion of value of thermal insulating to the tog unit can be written as the following:

$$(VTI)\% = 100[1\text{-}(Io/I1)]\,, \quad (22)$$

where Io and I1 are tog values of unclothed and clothed bodies, respectively, where 1 tog=0.418 m^2 s ^{o}C / cal.

3. Results and discussions

The results obtained and their analysis have a practical use, as they allow to estimate the cold protection effectiveness of textile layers in an assembly, anticipated for the production of winter jackets at the design stage, thus enabling possible changes depending on the conditions of application of the jackets predicted. Several goals were established for statistical analysis of the data. The first is to determine a generic equation, which would be capable of explaining the data. The second is to determine whether the synthetic membrane can be used to predict transport of pesticide from contaminated clothing fabric through human skin. A third goal is to test the effect of fabric and finishing had on the pesticide penetration rate using the general linear model. To determine a realistic insulating value at the personal clothing a starch crinkles woven fabric was made. Six materials with different weight fabric samples (25 cm x 25 cm) were arranged with Lycra starch yarn as 14:14 weft. In samples were then removed and passed through a laboratory experiments and calculation, with 3 samples at a time and then put back into the lee instrument for 3 minutes. Starched samples Were then dried at 21 ^{o}C,65 % relative humidity and conditioned for 24 h. The fabrics had a starch add-on of the fabric laboratory experiments (Table 2).

Table 2 – Result of laboratory experiments

Type	S. number	Code	sample Weigh/g	Thickness Mm	Thermal					Air permeability (m3 / sec .m2)
Plain weave 1/1 (group one)					Thermal factor K	Ǿ1	Ǿ2	Δ Ǿ1	(d Ø /dt)Ǿ1	
Cotton	1	1/1	1.4	0.8	0.005814	71	100	41	1.3	31
Lycra	2	10/1	1.23	0.75	0.010438	83	100	53	2.86	27.2
Fibran	3	5/1	1.23	0.75	0.00426	70	100	40	2.06	30.25
Viscose	4	3/1	1.38	0.8	0.007203	74	100	44	2.83	30.2
Blended	5	4/1	1.42	0.8	0.002718	63	100	33	1.52	32.0
Polyester	6	2/1	1.1	0.7	0.004855	74	100	44	2.18	30.3
Cotton + lycra	7	6/1	1.65	3.3	0.077025	44	100	14	1.58	30.25
Fibran +lycra	8	9/1	1.42	3.6	0.003458	43	100	13	0.662	32.1
Blended +lycra	9	11/1	1.35	3.2	0.009013	45	100	28	1.43	32.2
Viscose +lycra	10	8/1	1.54	3.3	0.005197	48	100	18	0.99	32.1
Polyester + lycra	11	7/1	1.33	2.5	0.00343	47	100	17	0.88	32.4
Viscose + Blended	12	12/1	1.24	0.75	0.003548	68	100	38	1.82	28.3
Vertical Spider weave(group two)										
Cotton	13	1/2	1.54	1.1	0.00673	70	100	40	2.22	32.8
Lycra	14	3/2	2.1	2.0	0.00426	55	100	25	1.16	31.3
Fibran	15	6/2	1.31	1.1	0.00607	60	100	30	2.67	30.2
Viscose	16	4/2	1.46	1.0	0.00469	63	100	33	2.1	32.9
Blended	17	5/2	1.54	1.1	0.00323	60	100	30	1.42	32.6
Polyester	18	2/2	1.11	1.0	0.00361	62	100	32	1.66	33
Cotton + lycra	19	7/2	2.2	3.5	0.00314	41	100	11	0.64	30.5
Fibran +lycra	20	11/2	2.7	5.5	0.00464	60	100	30	2.04	32.3
Blended +lycra	21	10/2	2.69	3.9	0.00627	44	100	14	1.09	32.3
Viscose +lycra	22	9/2	2.77	4.1	0.00565	46	100	16	0.9	32.5
Polyester + lycra	23	8/2	2.65	3.3	0.00437	47	100	17	0.85	32.7
Viscose + Blended	24	12/2	1.3	0.95	0.00276	59	100	29	1.44	32.7
Squared weave(twill/satin weave)(group three)										
Cotton	25	1/3	1.49	0.9	0.001786	63	100	33	0.888	32.2
Lycra	26	0/3	2.17	1.7	0.006051	63	100	33	1.592	30.9
Fibran	27	5/3	1.36	0.75	0.003722	74	100	44	1.56	32.3
Viscose	28	3/3	1.48	0.95	0.003414	64	100	34	1.564	32.2
Blended	29	4/3	1.45	0.8	0.002332	58	100	28	1.48	32.1
Polyester	30	2/3	1.12	0.6	0.003758	71	100	41	2.196	32.5
Cotton + lycra	31	6/3	2.74	3.5	0.009728	50	100	28	1.68	32.3
Fibran +lycra	32	7/3	3.09	4.6	0.013395	50	100	20	1.76	31.2
Blended +lycra	33	10/3	2.84	5.6	0.1010	49	100	19	1.112	30.9
Viscose +lycra	34	9/3	2.97	4.9	0.004632	44	100	14	0.64	32.3
Polyester + lycra	35	8/3	2.42	3.4	0.00610	48	100	18	1.128	32.5
Viscose + Blended	36	11/3	1.26	0.8	0.00433	64	100	34	2.36	32.3

*the scientific heat for copper =0.1, weight of disk = 650 grams , D of samples 10 cmm; Material + Lycra means (14 weft from the kind of material + 14 from Lycra);

Δ Ǿ1= Ǿ1 – temperature of laboratory**.**

The calculation of heat transfer demonstrated that the laboratory lee disk of the fabric whatever cotton, viscose rayon, fibran, polyester blended or lycra is the major factor.

Table 3 presents the Result of Pearson Correlation for 36 samples and the relationships between weight and thermal insulation.

Table 3 – Result of Pearson Correlation for 36 samples

Statistic items	CODE	Weight/grm	K. THERMAll	Air permeability
Pearson Correlation Sig. (2-tailed) N	1.000 .0 36	.317 .060 36	.109 .527 36	.213 .213 36
Pearson Correlation Sig. (2-tailed) N	317 0.60 36	1.000 . 36	.253 .136 36	.185 .281 36
Pearson Correlation Sig. (2-tailed) N	.106 527 36	.253 .136 36	1.000 . 36	-.219 .199 36
Pearson Correlation Sig. (2-tailed) N	.213 213 36	.185 .281 36	-.219 .199 36	1.000 . 36

Figure 2 shows the conducted relationship between the woven fabric construction and the specific materials with thickness at the three woven fabrics construction. Apparently from the figure that the vertical spider weave and used arranging weft as 14 lycra and 14 of specific materials (cotton, viscose, blended, fibran) is highest value of thickness than the any material without lycra, in addition to the that the vertical spider weave fabrics have maximum thickness behavior is higher than the plain weave in group one and the Squared weave(twill/satin weave)in (group three). This behavior indicates that the filling spaces in between fiber-to-fiber and yarn-to-yarn in the fabric, construction is increasing by floated the warp and filling up. Obviously, the specific volume is significantly influenced by the thickness content as bulking.

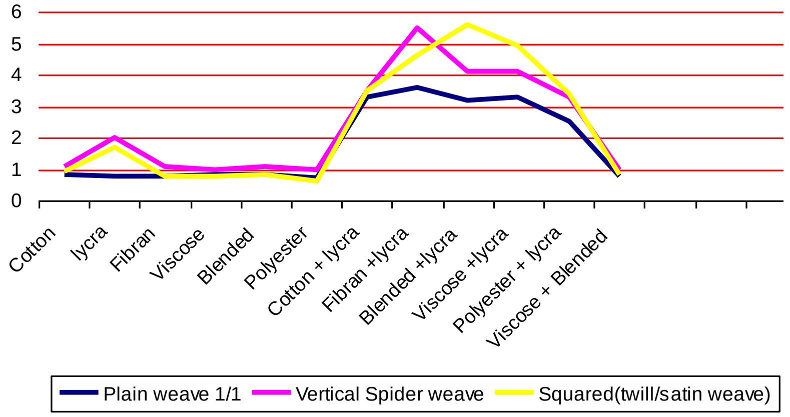


Fig. 2

Figure 3 shows the conducted relationship between the woven fabric construction and the specific materials with weight at the three woven fabrics construction. Apparently from the figure that the vertical spider weave and used arranging weft as 14 lycra and 14 of specific materials (cotton, viscose, blended, fibran) is highest value of weight than the any material without lycra, in addition to the that the vertical spider weave fabrics have maximum weight behavior is higher than the plain weave in group one and the Squared weave (twill/satin weave) in (group three). This behavior indicates that the filling spaces in between fiber-to-fiber and yarn-to-yarn in the fabric, construction is increasing by floated the warp and filling up. Obviously, the specific volume is significantly influenced by the weight content as bulking.

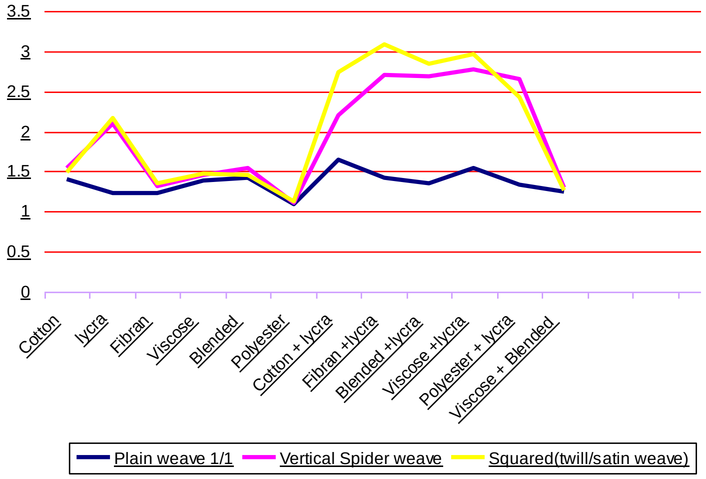


Fig. 3

Figure 4 shows the conducted relationship between the woven fabric construction and the specific materials with thermal insulation as the opposite of heat transfer at the three woven fabrics construction. Apparently from the figure that the vertical spider weave and used arranging weft as 14 lycra and 14 of specific materials (cotton, viscose, blended, fibran) is highest value of thermal insulation than the any material without lycra, in addition to the that the vertical spider weave fabrics have maximum thermal insulation behavior is higher than the plain weave in group one and the Squared weave(twill/satin weave)in (group three). This behavior indicates that the filling spaces in between fiber-to-fiber and yarn-to-yarn in the fabric, construction is increasing by floated the warp and filling up.

Obviously, the specific volume is significantly influenced by the thickness content as bulking.

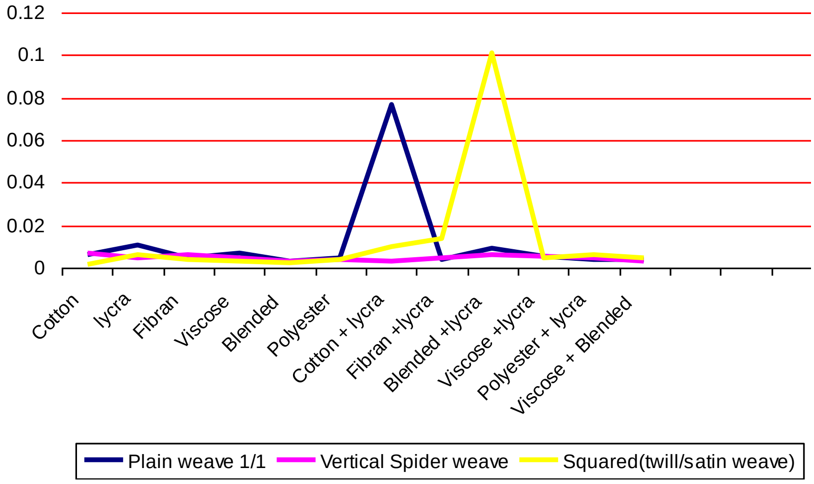


Fig. 4

Figure 5 shows the conducted relationship between the woven fabric construction and the specific materials with Air permeability at the three woven fabrics construction. Apparently from the figure that the vertical spider weave and used arranging weft as 14 lycra and 14 of specific materials (cotton, viscose, blended, fibran) is highest value of Air permeability than the any material without lycra, in addition to the that the vertical spider weave fabrics have maximum Air permeability behavior is higher than the plain weave in group one and the Squared weave(twill/satin weave)in (group three). This behavior indicates that the filling spaces in between fiber-to-fiber and yarn-to-yarn in the fabric, construction is increasing by floated the warp and filling up. Obviously, the specific volume is significantly influenced by the floated of warp and weft.

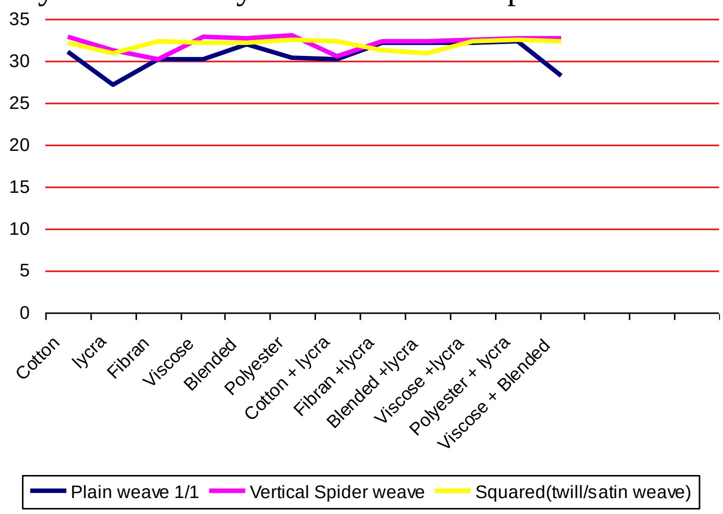


Fig. 5

It is therefore said that here are a number of factors influencing the bulking and thermal insulations for given us Comfort ability: So the natural fibers have The ability of fabric to absorb liquid water associated with wearing fabric and dynamic water levels and thermal insulation in the clothing.

This is a more important factor than water vapor permeability in determining the comfort factor. This observation is great agreement with observation added that Comfort ability is the ability of fiber to absorb water regardless is natural or synthetic. It is important to realize that the fabric setting as well as the fabric design(especially vertical spider weave, twill/satin)will play an import part for bulking fabrics. The transfer of water by means of fabric absorption according to the physical properties appears to be much more efficient way to keep the water vapor pressure very high. Consequently the heat transfer is positively high , but also in other scientific and engineering fields involving heat transfer in porous media throws air permeability .The work presented here is only a limited set of conditions such fabric material, construction and ambient condition. The data obtained in this investigation would have significant involvement for the conformability and survival factors of the fabrics as: Cotton is stronger thermal insulation a remarkable capacity to absorb moisture.

The Viscose Rayon is a cellulosic fiber, which makes it natural and breathable. Viscose Rayon is lightweight, soft, drapeable, have significant of thermal insulation and comfortable to wear.

The non-cellulosic manmade fiber family includes acrylics, nylon, polyester, spandex, etc. Most of these fibers are ill suited for period garment construction. If you've found something you have fallen in love with and must use, then it is best to line it with a natural fiber so that the garment will have some breathability and thermal insulation. It is important to realize that the fabric setting as well as the fabric design (especially vertical spider weave) as bulky woven fabrics will play an import part for thermal insulation. The transfer of water by means of fabric absorption according to the physical properties appears to be much more efficient way to keep the water vapor.

4. Conclusions

In this study results are presented from the insulation abilities of 36 clothing items for cold protection from the point of view of thermo physiological comfort. Three options of fabric structures are possible: to increase the insulation abilities of the fabrics, anticipated for the production of winter clothes, to increase the insulation ability of the other clothing items, or to relay higher activity and shorter exposures to the cold environment. The results obtained and their analysis have a practical use, as they allow to estimate the cold protection effectiveness of textile layers in an assembly, anticipated for the production of winter clothes at the design stage, thus enabling possible changes depending on the conditions of application of the clothes predicted, based on the pervious calculated and experimentally results of the selected fabrics that used as thermally insulators, the following conclusions are drawn:

The laboratory experiments and calculation have shown that the selected textile fabrics can be used as good thermal insulators in range of exposure temperatures of 40-200 ^oC.

The study concludes that the selected fabrics have high thermal performance and thermal response as insulators. The effect of fabric thickness crinkles on the fabric temperature variations has obviously significance that the higher thickness crinkles means good thermal insulation. Both the thermal conductivity and thermal resistance of all selected fabric samples increases with increasing of fabric density. Fabric thickness by crinkles affects the transient fabric temperatures that fabric temperature variation decreases with increasing fabric thickness with light weight. The exposure temperature affects the heat flow through the selected fabrics, which heat flow increases with increasing exposure temperatures. The temperature variations of the fabric increased with increasing of time and also decreased with fabric weight up to a certain limit, beyond its optimum level.

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