EFFECT OF STRETCH POTENTIAL ON VOLUME POROSITY AND AIR PERMEABILITY IN KNITTING FABRICS

EISayed A. ElNashar

Faculty of Specific Education, Kafrelsheikh University, Egypt.

El-Geish Street, 33516 Kaferelsheikh City, Egypt

E-mail: smartex@kfs.edu.eg, Dr_elnashar@yahoo.com

Abstract: The aim of this paper attempts to investigate the relationship between stretch potential on volume porosity and light permeability of the knitted structures, to find a suitable model that makes possible the prediction of air permeability of a Knitting fabric on the base of its constructional parameters. The methodology: As the constructional parameters of Knitting fabric are considered: gauge of twist factor, yarn count yarns, diameters (or fineness) of yarns and a type of weave structures. This research is focused on clothing woven fabrics of a cotton type. Two variants of so-called cumulative parameter of a Knitting fabric structure are defined and they are applied on the set of Knitting fabrics. Porosities evaluated from empirical analysis and basic knitting wefts structural parameters (kind of material, yarn diameters and loop length / gauge setts). the cotton single jersey of weft knitting constant sett of gauge and varying sett of weft and varying yarn fineness are used for predictive model building. the obtained results, this new (emp-the) empirical theoretical model of stretch potential on Volume Porosity and air Permeability in knitting fabrics are created and evaluated by the combination of partial of samples, numerical without graphs and suitable criterion expressing the predictive ability, a correlation between calculated values of structural parameters and experimental air permeability values was evaluated. Conclusions, in the first step the principal component analysis of volume porosity and air permeability in knitting fabrics, leading of new factors to the design suitable for end-use.

Keywords: stretch potential, air permeability, knitting, structure, porosity.

1. INTRODUCTION

The concept of "Stretch" as a term applied to stretch potential on volume porosity and air permeability in knitting fabrics is still a fresh word in the glossary of fashion. Originating in Europe, where the stretch concept is based on the idea of making garments that move with the body, [18] rather than those that inhibit movement, a large volume of the fabric remains occupied by airspaces because of the way in which the yarns and fabric are constructed. This implies that there are a large number of porous areas within a given knitted fabric structure. Therefore, volume is the amount of space occupied by an object or a material, then volume porosity is the amount of space occupied between loops of knitted fabric, or the amount of space occupied by a three-dimensional object or region of space between loops of knitted fabric, Porosity is the ratio of the total amount of void space in a material to the bulk volume occupied by the material. Fabric porosity is an important parameter in assessment of clothing comfort and physical properties of technical textiles [10] [13] [9] [17]. Several studies have been carried out to analyse the dimensional properties of knitted structures with prevailing these from Chamberlain (1926) [6], Peirce (1947) [27], Leaf and Glaskin (1955) [25], Doyle (1953) [8] and Munden (1960) [26]. These studies have presented either formulated geometrical models consisting of known curves, for example circular arcs and straight lines, or the results of measurements that have been carried out on a series of knitted structures (Demiroz and Dias, 2000) [7]. The present work focuses on the estimation of the geometrical characteristics of a single jersey knitted fabric structure supporting the maximum possible accuracy in order to ensure the numerical modeling success by new equations with

experimental on contact analysis. the objectives of the research was to come up with a model that can predict the effect of stretch potential [24] , on volume porosity and air permeability in knitting fabrics structures using their geometrical details.[24].

1.1. Weft knitted structure porosity

Plain weft knitted parameters structure such as the courses per unit length, wales per unite length and loops density, the effect of loops length, and yarn liner density on volume pore size as a basic elements of a knit fabric structure is the loop intermeshed with loops adjacent to it on both sides and above and below it.

Figure 1. Representation of a plain weft knitted structure. [5] Where: Wales/ cm = $1/w = w$, Courses/ cm = $1/C = c$, Loop length = AB/mm , Loops/ $\text{cm}^2 = S$

Then characterize a pore within loop, which is the unit cell of a plain knitted structure, between the fiber of the yarn in the loop, and the calculated from measurement of fabric thickness with a thickness gauge and yarn diameter as in the following:

$$R' = t/4 \quad (1)$$

$$\text{Since, } R = \sqrt{R' R''} \quad (2)$$

$$R'' = R^2/R' \quad (3)$$

And loop length as the Peirce equation [27]:

$$l = 2/c + 1/w + 5.9 d \quad (4)$$

Where: l = length of yarn on loop, cm; c = number of courses per cm; w = number of wales per cm; d =dimeter of yarn, cm.

S , the number of loop/ cm^2 of fabric or loop density is defined as follows:

$$S = c \times w \quad (5)$$

We can calculate volume of free space (cm^3) , inter-yarn, 1 cm^2

$$Fabric = 1x1xt - Sl \pi R^2 = t - SlSl\pi R^2 \quad (6)$$

Where t is fabric thickness, area of free space (cm^2) in 1 cm^2

$$Fabric = \frac{t - Sl \pi R^2}{t} \quad (7)$$

Since S is the number of loops in 1 cm^2 , the area of open space within one loop can be given as follows:

$$Area \text{ of open space within one loop} = \frac{t - Sl \pi R^2}{tS} \quad (8)$$

The pores in a fabric are not circular, however, if the area occupied by a pore is transformed to that of a circle, one can estimate pore radius by the following:

$$Pore \text{ radius} = \sqrt{\frac{t - Sl \pi R^2}{\pi t S}} \quad (9)$$

So loop length and yarn diameter incising pore size values decreases, As indicated by equation of The linear density (tex) of a yarn can be given as follows:

$$T = \frac{\pi d^2}{4} P_y 10^5 \quad (10)$$

Where: T is the yarn linear density (tex), d is the yarn diameter (cm) and p_y (g/cc) is the yarn, density. Peirce used a value of 0.909 (g/cc) for p_y for cotton yarn. And yarn diameter, d , can be shown to be as follows:

$$d = \sqrt{\frac{4T}{\pi P_y 10^5}} \quad (11)$$

When the knitted fabric is treated as a three-dimensional formation, void spaces (pores) can be situated in the fibers, between fibers in the yarn, and between loops threads in the fabric. For these last pores, the term “macropore” is also used. As textile materials, fabrics knitted structures, the most exactly determined inner geometric model of a porous structure in form of a tube like system, where each macropore has a cylindrical shape with a permanent cross section over all its length [13]. the density loops in knitted fabric is usually greater than the gauge density; the elliptical shape of the pore cross section is used to represent the situation of *compact force* [20] [14], to compare woven fabric with porosity, a lot of models for description of porosity in woven fabrics distinction can be made among porosity between yarn, an inter-yarn porosity, and porosity between fibers inside yarn, an inter-yarn porosity, from the point of view of an air permeability evaluation. Permeability of porous materials depends very strongly on the morphological structure. Due to the complexity of the fiber architectures and the lack of an adequate mathematical model, many researchers continue to determine permeability experimentally.[18] The main aim of theoretical analysis of volume porosity and air permeability of textile materials is usually to find relationship between an air permeability and structure of knitted fabrics. A knitted fabrics structure is in this case usually represented by its porosity. For a determination of the porosity, a number of theoretical and experimental methods exist. then the porosity indicates how much air a knitted material contains of loops densities distribution for a description of physical properties of knitting fabrics throw a configuration of pores in knitting fabrics (the pore size, shape, arrangement etc.) are very important. We are develop a method to predict the volume porosity by equations analysis as a theoretical model, which used as empirical to predict the volume porosity and air permeability and radius of capillaries of weft knitted spacer fabric based on the geometrical parameters and they found that the porosity and capillary radius of weft

knitted spacer fabric influenced by the number of spacer yarn. In this work which can be used to handmade calculate the porosity of plain weft knitted fabric is developed. Requires only few input parameters to generate 3D geometrical model of a plain weft knitted fabric. Comparisons of volume porosity of plain knitted fabrics are made between results obtained from experimental work.

2. MATERIALS AND METHODS

In this work a plain weft knitted fabrics made with different yarn (19.6, 14.7 tex) of acrylic fibre, Twist factor 2.25, were used in order to evaluate the effectiveness of the developed. In case of staple fiber yarn intra yarn porosity was also considered in the calculation of porosity. Table 1 shows the fabric specifications of plain weft knitted fabrics of circular knitting machine (Paolo Orizio), gouge 28/inch , Wales/cm = $(1/w=w) = 10$ per cm on machine were fabrics described. In a research, the porosity of plain weft knitted fabric is expressed laboratory of consolidation fund at Alexandria Egypt for and air permeability of textiles fabrics ASTM D737-96 [1], and the Stiffness, weight, and Thickness tests have been carried out for textiles research labs, in faculty of Specific Education, Kafrelsheikh University, Egypt.[12] According to ASTM D 1388 – Standard test method for stiffness of fabrics [2], and ASTM D3776 / D3776M – 09a Standard Test Method for mass per unit area (weight) of Fabric [4, 3], by using EINashar Digital Tests Methods for weight, durability, stuffiness, strength and elongation for fabrics, ASTM D1777 – 96 (2007) Standard Test Method for Thickness of Textile Materials [3], by using EINashar Digital Thickness Test Methods.

The distinction between knits and stretch potential on volume porosity is important for simulation because their mechanical structures are entirely dissimilar, and as a result they behave differently at all scales. The yarns in knitting fabric are nearly immobile, leading to an almost inextensible sheet with limited deformations in the yarn structure. In contrast, the loops in a knit material deform and slide readily, leading to a highly extensible sheet with dramatic changes in small-scale structure as the material stretches [22-23].

3. RESULTS AND DISCUSSION

Modified 2D model of porosity, in knotting fabrics includes partly a 3D structure of pores. A various pores type does not show the same relationship between a projected and real effective area opened for the flow. The influence of the pores was described with loop basic unit cells. Each type of knitting fabric can be described by the following pore type. The structure parameters of uncut loop (densities of loops, basic structure of loop; linear density of loop; degree of loop ratio of uncut the loops, material of loop. were carried out on single-jersey knitting fabrics, as shown in table (1) which were constructed according to the setting theory. All samples before the measurements were conditioned in accordance with standard. A correlation between porosity and air permeability of a fabric is very complicated because a structure of knitting changes by influence off machine (linear density) system is possible classified as a horizontal increase of the porosity, removing of free loops are interlaced very closely in single-jersey knitting fabrics, relative removing of yarns cause an increase of its porosity predominantly in a vertical direction. Flowing air cause a move of not interlaced parts of loop floats between vertical wales and the horizontal Courses increase of porosity can result in a considerable increase of air permeability, moisture permeability, and vapor permeability. Therefore an interesting material for different application such as garment and technical end-uses to determine knitted fabric porosity, several methods have been developed (optical methods or those based on liquid penetration, absorption, filtration, airflow, etc.). To find the diameters of warp pile cross-section d the cross-section of yarn as indicated of in the following equation [13]:

$$d = 4.44 (\sqrt{\text{Tex count/fiber density}}) 10^{-3} \text{ cm.} \quad (12)$$

Then, we can calculate the weight as the following:

$$W = \pi (d/4) L * \text{number of loop threads in knitted fabrics.} \quad (13)$$

Where: W =(weight), L =(length of loop).

3.1. Presentation of the Geometrical Model

The main structural parameters of a single jersey fabric are the course-spacing, the wale-spacing and the thickness of the yarn. The rest of the geometrical parameters required for the complete description of the structure derive analytically from the geometrical parameters. Thus the yarns are represented as homogenous cylinders of constant diameter, with initial restricted contact area between them. in figure 1. And this equation gives us more fitting results, it calculates the volume porosity and inner porosity, especially when use the knitted cloth. This model was constructed to have a geometry complicated enough to see the effect of changing the medium location but simple enough to save computational time. Due to geometric symmetry, four different high-permeable medium locations were examined. The permeability of the Seaman high-permeable distribution medium was used in the simulations as the following calculate the knitted fabrics porosity construction % in regular constructors system with plain structure of knitted fabrics by using the flowing figure and equation:

Figure 2. Representation New Model of a plain weft knitted structure

We calculate volume porosity (V_p) and defined by the following equations.

$$VP = \frac{1000 \pi [2d_V d_H \gamma 4T D_Y]^{10/2}}{d_{NK} T \gamma \sqrt{[1-0.01 C_{VH}]100}} + \frac{L_{LY} R_W}{N_{YR}} X \frac{1}{IFC} \quad (14)$$

Where symbols description for equation:

V_p = volume porosity; T_{NK} = thickness of knitted fabrics; T : Yarn count in Tex system; C : Crimp for knitted fabrics (vertical- horizontal); D_y : Density of yarns/cm; γ : Scientific (fiber) density for cotton (1.54), viscose (1.46), polyester (1.38), Acrylic fiber density is 1.17 (g/cm³); d_V : Vertical Cross section for loop yarn; (d_H): Horizontal Cross section for loop yarn; L_{LY} : Length of loop yarn "weft" extended between tow intersection in perfect repeat of knitted construction; R_W : Width of repeat of loop "wale"; N_{YR} : Number of Crouse repeats for loop "weft"; IFC : Integration factor construction [IFC (in regular structure) gouge) = 1]. [10]

$$IFC = \Sigma(\alpha X W) / n \quad (15)$$

Where: α : Balance factor of knitting construction. W : width of stripe (density). n : number of wale width stripes (density). Where: $K = C n \sqrt{N}$. For direct system. C = is the constant for material, (0.04126 for Tex.). n = number of course threads per inch. N = yarn count.

3.2. Calculation of the Loop Length [16] [15]

Due to the symmetry of the unit cell the length of the loop is received by the equation 12.

$$L = 4 \cdot \text{arc}(\Sigma M) + 4 \cdot \text{arc}(MK) + 2 \cdot \text{arc}(KP) \quad (16)$$

$$\text{Where } \text{arc}(KP) = 2\theta \cdot k / \sin \theta \quad (17)$$

Basic parameters of a knitting fabric are: loop width Ωr , loop height Δr , loop length ℓ_{pi} ,

$$\ell_{pi} = \pi \Delta r - \Omega r \quad (18)$$

Where ℓ is loop length [mm], Ωr is loop width [mm], Δr is loop height [mm]

$$p_1 = 2d p_i + d_2 \quad (19)$$

$$p = 4d p_i + 3d_2 \quad (20)$$

Where: p_1 is space between wale of loop; P – widths repeat; $d p_i$ - pile yarn thickness [mm].

The loop length is influenced by the yarn input tension, Knitting fabric take-down tension, loops interlacing velocity, materials friction in the loop zone, yarn structure and properties, yarn linear density, etc. The knitting fabric vertical density W : is defined by the loop density and the yarn input tension; it changes only slightly with the change of the yarn input tension for conventional yarns for elasticized. The vertical density of the knitting fabric changes with depth change. The loop length increases and simultaneously the vertical density are reduced. Volume porosity and air permeability depending on the materials relaxation process usually comprises shrinking of the plain knitting fabric, Dry relaxation begins immediately after exiting the loop interlacing zone when the tension applied to the loops during the knitting process is reduced. The relaxation takes some time, depending on the yarn material composition, the horizontal/vertical (wales and course) density and the structure of the knitting fabric, and loads applied to the fabric prior to relaxation. The portion of the immediate shrinkage natural materials fabric is wet relaxed during wet after-treatment processes like bleaching and dyeing and additionally during the care process, e.g. laundering and steaming. Theoretically, a knitting fabric changes continually and perpetually tends to attain more stable state than the previous one. The changes are also influenced by the factors like temperature, relative humidity, pressure of materials etc. As the changes are not visible anymore the state is comply with the order. The main structural parameters of a plain knitting fabric are: the head of loop-spacing (P): Widths repeat. The knitting fabric vertical density (w) and the thickness of the loop yarn. The rest of the geometrical parameters required for the complete description of the structure derive analytically from them. The estimation of the geometrical parameters has been based on the assumption of the ideal cotton yarn of knitting fabrics. Thus the yarns are represented as homogenous cylinders of constant diameter for loop and ground, with initial restricted contact area between them. We consider initially the independent parameters c , W , d and in addition the: distance t as it is

noticed in figure (2) Geometrical model of plain knitting fabrics structure. Due to the symmetry of the unit cell the length of the loop is received by yarn crimp ratio cross-section change is not neglected it may be assumed, that greater angel of contact will be connected with more important change of yarn cross-section from circular into approximately elliptical. Due to the symmetry of the unit cell the length of the loop is received by the equation:

$$c = \frac{\pi(d)}{180\sqrt{d_{vertical}^2 + 2d_{horizontal}^2}} + (\pi\Delta r - \Omega r) \cos^{-1} \frac{d}{d_{vertical}^2 + 2d_{horizontal}^2} - 1 \quad (21)$$

3.3. Evaluation of the Geometrical Model

The evaluation of the geometrical model is based initially on the comparison of the experimentally defined loop length of a given fabric to the respective calculated by the geometrical model for the same main parameters (c , w , D). The main structural parameters of a fabric can be defined after a microscopic observation and the loop length can be measured using the crimp tester. Table 1 contains the main parameters, the measured loop lengths and the geometrically calculated loop lengths for eight randomly selected fabrics. The error between the calculated loop length and the measured one is considered as the indication of the accuracy of the geometrical model.

Table 1. Element of geometrical porosity and air permeability of a plain knitted loop

N	Count tex	Fiber density (g/cm3)	Loops /cm ² =S	Wales /cm = (1/w= w)	Courses /cm = (1/C= c)	Thickness mm	Areal density (g/m2)	Air permeability	Volume Porosity %	Stiffn ess
1	19.6	1.28	2.25	13.5	15	2.48	145.12	56.3	19.7	41.8
2			3.2	12.5	14.5	2.68	127.37	62.2	18.3	39.8
3			3.8	11.3	14	2.97	95.20	65.4	17.1	37.6
4	14.7		2.24	13.5	16.5	2.55	125.7	57.3	20.2	40.8
5			3.2	12.6	15.5	2.83	111.12	63.5	21.6	37.8
6			3.8	12	14.6	3.2	87.12	67.3	22.9	41.8

These models were suggested includes partly 3-D structure of pores. A various binding type does not show the same relationship between a projected and real effective area opened to a flow. The modified 2-D model of porosity is based on idea that air flows around of yarns not only in a perpendicular direction. the flowing equation, has focused on the creation and the evaluation of a three-dimensional plain knitted fabric geometrical model. The precision of the geometrical model has been cross-checked by using geometrical and mechanical criteria. Especially the mechanical criterion is considering the success of the geometrical model taking in account the final results of the finite element analysis of the structure created. However more realistic models based on a better approach of geometry and material properties will be created in order to investigate the numerical analysis performance of the mechanical properties of knitted fabrics.

For detection of geometric characteristics of structure of plain knitted acrylic, the method of direct research of inner structure of fabric was used. It was done with help of analysis of soft of fabric samples, introduced in the individual parameters of bent plane knitted fabric were measured to the evaluation of the geometrical model is based initially on the comparison of the experimentally defined loop length of a given fabric to the respective calculated by the geometrical model for the same main parameters (c , w , D). The main structural parameters of a fabric can be defined after a microscopic observation and the loop length can be

measured using the crimp tester. Table 1 contains the main parameters, the measured and calculation loop lengths and the geometrically calculated knitted loop lengths for six group randomly selected fabrics. The error between the calculated knitted loop length and the measured one is considered as the indication of the accuracy of the geometrical model. Correlation between a structural parameters and air permeability experimental values for all fabrics the air permeability values were measured. and relationships between experimental porosity and air permeability values and structural characteristics of knitted fabrics (determined according to method). were used for measuring of air permeability of knitted fabric. The all parameters of loop structure mentioned above were calculated and for all fabrics porosity and air permeability was measured. Apparently from the table1 and figure 3 that the specific volume of porosity and air permeability are shown constructional parameters of used fabrics and levels of loop. The specific volume is significantly influenced by behavior of the spaces in between structural characteristics values of porosity and air permeability in low level of loop and their deviations from experimental knitted fabrics air permeability values. Evident that in the cases of relatively “opened” fabrics the suggested method gives relatively good results. In the cases very dense fabrics the results (predicated values of knitted fabrics of porosity and air permeability) are not so accurate.

Figure 3. Coloration between elements of geometrical volume porosity and air permeability and stuffiness of plain knitted fabrics

3.4. Compact Stretch Potential

Yarn mass per length unit, threads density, stretch potential and weave determine the size and the shape of the stretch surfaces on a plain weft knitting fabrics, which are covered with weft threads, stretch potential geometrical models of single, with the weft interlacing; the diameters of the weft threads, and $1/gw$ and $1/gf$ the spaces volume porosity and air permeability between the loops of plain weft threads, the size of the stretch weft interlacing point surface is calculated from the geometrical model. With further analysis of the weft interlacing point geometry the fractions of individual porosity surfaces are mathematically defined with regard to the entire porosity repeat. The surfaces are defined by considering the porosity and the place of appearance in the fabric. The geometry of the weaves with larger repeat differs from plain weft knitted structure in the size of porosity repeat, which means in the number of the weft stretch interlacing points in the smallest porosity repeat unit. Wavelengths are defined with optical properties of the substrate. If reflectance R (%) and colour values L^* , a^* , b^* of the weft threads-w and potential weft threads-f and substrate-p are considered, the reflectance and $L^*a^*b^*$ values of a fabric can be expressed with Equations (22) to (26). $SR_{W\%}$ the ratio stretch potential of weft direction:

$$R_{tk(\lambda)} = (R_w u_w)_{(\lambda)} + \frac{(R_f u_f)_{(\lambda)}}{SP_{W\%}} + (R_p u_p) \quad (22)$$

$$L_{tk}^* = (L_w^* u_w) + \frac{(L_f^* u_f)}{SP_{W\%}} + (L_p^* u_p) \quad (23)$$

$$a_{tk}^* = (a_w^* u_w) + (a_v^* u_v) + (a_p^* u_p) \quad (24)$$

$$b_{tk}^* = (b_w^* u_w) + \frac{(b_f^* u_f)}{SP_{W\%}} + (b_p^* u_p) \quad (25)$$

Where d = Yarn diameter in cm, Nt = Yarn number in tex (g/km), pf = Fiber density (g/cm³), py = Yarn density (g/cm³)

$$\text{Yarn packing fraction (or factor)} = \phi = \frac{(\rho_y)}{(\rho_f)} = \frac{\text{Yarn density (g/cm}^3\text{)}}{\text{Fiber density (g/cm}^3\text{)}} \quad (26)$$

3.5. Compact Force in Plain Weft Knitted Structure

Circle of loop pattern are the face of the original elements of artwork into three smaller during this all-quad plain weft knitted structure mesh conversion, of weft yarns that appears on the fabric faces, which is a function of the constructional parameters (weft densities, fiber densities, loop length/ gouge setts), arrangement, the changing between stretch potential and porosity). To predict contribution of each air permeability/volume porosity to the fabric surface, we considered idealized fabric geometry with the following assumptions to simplify calculations since real fabric construction parameters are rather complex in their shape:

1. Yarns' diameters are uniform cylinders. 2. Loop length/ gouge setts spacing at the intersection and under the float is constant. 3. Stretch potential at the plain weft knitted structure intersection and under the float is constant. 4. The projection (two-dimensional) of the plain weft knitted structure on a plane parallel to fabric plane is considered. 5. Yarns' are uniformly in plain weft knitted structure/ volume porosity.

3.6. Compact Force Models

Compact force mathematical models were worked into different structures of plain weft knitted structure with different assumptions. In these models, the kind of deformation occurring with the effect of spatial force acting upon a fabric placed on a square frame was studied. The main assumptions here were the plain weft knitted structure yarn elongation, the intersection angles between the weft systems, and during the deformation period, because of loop yarn elongation, a shape like a pyramid, square and circles shapes having occurred. So the compact force needed for deformation was calculated with the plain weft knitted structure. the conditions that these computer programs symbolize in general are represented in Figure 4: L0 – The side length of the square frame in which the fabric is placed; N – The number of the weft yarns in the frame; M – The number of the weft yarns in the frame; N/2 – The number of the yarns to the middle point of the frame; j – The weft indices; i – The weft indices.

Understanding how panels are created, and being certain which way up they are compact force of surface has been designed to be as easy to use as possible. Throughout the program, the intention has been to make it possible for the user to create their structure with a minimum of key presses or button clicks. to achieve this aim, it has been necessary to make some relatively arbitrary choices about how certain parts of the software should work.

Figure 4. Stretch potential on volume porosity and air permeability. Geometric assumptions forming the fundamentals of the computer programs (a) Distribution of the pressing force, (b) Position at the perpendicular cross-section after deformation $L_0=2$: The length until the middle point of the frame side, $L_n=2$: The length of the yarn until the middle point of the frame side after deformation, (c) Comparison between before and after deformation

This is particularly so in that part of the software that deals with creating patterns. In order to minimize the choices that had to be made, and to streamline the process, a couple of specific conventions have been built into the software: 1) Of the two plain weft knitted structure lines that make up the edges of a given panel, the loop line with the lower number is deemed to be the left-hand side of the panel. 2) Each plain weft knitted structure type is deemed to run in a particular direction: horizontal loop run left-to-right, vertical Stitch s run top-to-bottom, right diagonal Stitch s run from top left to bottom right, left diagonal loop run from bottom left to top right, and geodesic loop run in the direction in which they were created. Let us examine what these conventions actually mean, and what affect they have on the actual panel-creation process. Consider the tent portion below: Tent portion with loops defined on it, the dark lines represent the loops. When surface calculates the panels defined by this loop (1) is deemed to be the left-hand side of the panel, and loop 2 the right-hand side. Next, it is necessary to find the start points of the loop. The fundamentals of the geometric assumptions of the computer program are shown in Figure 4 (a), (b) and (c). As will be seen in Figure 4 (b),

$$L_{n/2} = \left(\frac{\sin \alpha \sqrt{(L_0/2)^2 + D^2}}{D} \right) D / L_{0/2} \quad (27)$$

Can be detrained,

$$\left(\frac{\frac{j}{N/2}}{\frac{L_{oj}}{L_{0/2}}} \right) - \left(\sqrt{\frac{j}{N}} \right) + \frac{2j + L_j}{N} \quad (28)$$

j : The sequence of any weft yarn; l_{oj} : The initial length of any one of the weft yarns; l_j : The length of any one of the weft yarns after deformation, and $N/2$.

4. CONCLUSION

In this paper describe an experimental and computational approach to determine the effect of stretch potential on volume porosity and air permeability in knitting fabrics, and the creation and the evaluation of a three-dimensional of plain weft knitted structure geometrical model. The precision of the geometrical model has been cross-checked by using geometrical and

mechanical porosity and criteria. Especially the mechanical criterion is considering the success of the geometrical model taking in account the final results analysis of the structure created. However more realistic models based on a better approach of geometry and material properties will be created in order to investigate the numerical analysis performance of the mechanical porosity and properties of plain weft knitted structure. The suggested process makes possible prediction of knitted fabrics porosity and air permeability value of plain knitted fabrics, which are characterized by their constructional parameters as are sett of wale and course yarns, diameters or fineness of loops of fabrics and by the type of structure. On the base of the area covering value is chosen suitable model for description of knitted fabric structure. The porosity and air permeability value is predicted with use of chosen level and density. Two variants of cumulative parameter of plain weft knitted structure were introduced. Knitted fabrics are the preferred structures in athletic wear in which demand for comfort is a key requirement. Heat and liquid sweat generation during athletic activities must be transported out and dissipated to the atmosphere. A key property influencing such behaviors is porosity and stuffiness. Two parameters that characterize it are pore size and pore volume. One of the objectives in this research was to come up with models that can predict interyarn pore size and pore volume for simple weft knitted structures, from fabric particulars, such as courses and wales count, yarn size, *loop length / gouge setts* density, thickness and other geometrical details of the fabric, which characterize the structure. Such a model was developed that was based on the geometry of the unit cell of a single loop. The experimental work in this thesis involved using a set of 8 knitted fabrics that differed in course count and examining their pore structure and porosity related characteristics. The values of pore size and pore volume were calculated, those of pore size were measured with image analysis and fluid extrusion procedures, and the role of these in determining fluid holding and air and fluid transport properties were determined. The effects of course count and washing on *loop length / gouge setts* density, *loop length / gouge setts* length, fabric thickness and pore size are examined in detail.

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