Daiva Mikučionienė*,
Lina Čepukonė

Kaunas University of Technology,
Department of Materials Engineering,
Studentų str. 56, LT-51424 Kaunas, Lithuania
* E-mail: daiva.mikucioniene@ktu.lt

Comparative Analysis of Knits from Peat Fibre and its Combinations with Other Natural Fibres

Abstract

Natural and man-made fibres of natural origin are more and more widely used, while consideration of sustainability is constantly increasing. The properties and processing behaviour of newly introduced fibres of natural origin are usually compared and often predicted on the basis of widely investigated fibres; however, this prediction sometimes does not have any confirmed basis. Structural parameters and the majority of mechanical and physical properties of knitted fabrics depend on technical characteristics of the knitting machine, on the properties of yarns as well as on the origin of the raw material. This study attempts to develop knits from new natural peat fibres and their combination with widely used woollen, cotton and elastomeric Lycra yarns and to investigate the influence of peat fibre's nature on structural parameters such as loop length, wale and course spacing, area density, the tightness factor and on main physical properties such as dimensional stability, air permeability and water adsorption.

Key words: *knitted structure, peat fibre, shrinkage, air permeability, static water adsorption.*

Introduction

The world textile industry has undergone considerable changes because of the growing requirements of consumers for more specified and sophisticated products. An extremely wide choice of fibres is used in today's textile industry. Sustainable manufacturing of textiles as well as a sustainable lifestyle are becoming a more important goal of the world at present, and a great demand for more comfortable and certainly more environmentally friendly textile is observed. In this case, in the first place come natural fibres (man-made or of natural origin), which are characterised by their exceptional ecological properties. Textiles from natural fibres have exclusive properties such as there being no release of substances harmful for the health, not causing an allergy effect, high heat absorption, high air permeability and high hygroscopicity [1]. Thus the importance and impact of fibres of natural origin is growing and stimulates demand for them through promotion of their efficiency and sustainability. Peat fibre is a new type of cellulose fibre comprised of white fibres, i.e. of sheathed cotton grass (*Eriophorum vaginatum*), which is a common plant in peat bogs, and of dark brown fibres. When peat is excavated from bogs, it must be purified by separating it from other components. One major component is cotton grass fibre formed when the plant dies and partly decomposes. Cotton grass sedge constantly dies down and new plants create further layers on top of the dead bodies of older vegeta-

tion. Due to the acidic and anaerobic nature of the bog, the stem and root of the plant do not decompose totally, but deteriorate into a dark brown fibre. This fibre is a by-product of peat-excavation operations. Because of its excellent chemical, physical and biological properties, peat fibre has become one of the new ecological materials which have huge development potential. Peat fibres are polar, have a high surface area and a highly porous structure. These properties enable peat to hold a large amount of water. Structural parameters and the majority of mechanical and physical properties of knitted fabrics depend on the technical characteristics of the knitting machine, the properties of yarns, as well as on the origin of raw material [2, 3].

Clothing comfort includes three main considerations: thermo-physiological, sensorial and psychological comfort. The term ′comfort′ is a subjective concept which is recognised by the person experiencing it. It can be defined as a natural state compared to the more active state of pleasure. Thermo-physiological comfort is very important for casual wear, sportswear, underwear as well as for special functional clothing and includes heat exchange from the human body to the outside (through the clothing), air permeability as well as the transfer and evaporation of moisture [4, 5]. Clothing must assist the body's thermal control function under changing physical loads in such a way that the body's thermal and moisture management is balanced and a microclimate is created next to the

skin. The effects of various knitted structures on the dimensional, mechanical and comfort properties of knitted fabrics have been analysed by many researchers [6-8].

Weft knitted fabrics are characterized as having good characteristics such as high tensility, porosity, air permeability, softness, and warmth. However the dimensional stability of knitted structures is usually lower than for woven fabrics [9]. The maximum shrinkage of finished knitted fabrics is expected to be less than ±3%. Knitted fabric's shrinkage is a result of the combined effect of numerous factors such as relaxation (during different manufacturing phases), finishing, drying (mechanical and non-mechanical), and the effects of machinery (yarn spinning tensions, knitting tensions, migration of loops and changes in loop shapes) [10, 11]. Kalkanci and Kurumer (2015) noticed that the loop density and knitting pattern have an effect on transverse and lengthwise dimensional changes, whereas the yarn type and raw material of the yarn affect lengthwise dimensional changes more significantly [12]. Cotton as well as other cellulosic knitted fabrics tends to change dimensions during wet treatment. Dimensional changes after wet treatments have a high influence on the porosity of a knitted structure, occurring because of the influence of shrinkage during washing and drying under the impact of moisture, heat, and mechanical action [13].

Permeability to air is one of the most important properties of knitted fabrics

used for clothing. The air permeability and porosity of a knitted structure have an influence on the main physical properties such as the bulk density, moisture absorbency, mass transfer and thermal conductivity. The main structural parameters which have an influence on the air permeability of knits are the linear density of yarns, loop length, course and wale densities, and the knitting pattern [14]. Benltoufa et al. (2007) determined that the loop length of a knitted single jersey fabric has a higher influence on porosity and air permeability than the stitch density and thickness of the fabric [15]. Çoruh (2015) concluded that an increase in the loop length increases permeability to air and water vapour as well [8]. Zhu et al. (2015) investigated the effect of fabric structure on the air permeability and thermal resistance and was determined that the knitting pattern (type and range of knitting elements in a pattern repeat) has a significant influence on the air permeability and thermal resistance [16].

Another very important property which describes the thermo-physiological comfort of knitted fabrics is water adsorption. Natural and pure knitted fabrics can adsorb a higher amount of water than knits made from synthetic fibres, which are hydrophobic and tend not to adsorb moisture. Abramavičiūtė et al. (2011) determined that higher water adsorption is characteristic for knits from pure natural

yarns, and the adsorptivity of knits made from textured multifilament polyamide yarns is lower, with the lowest being of knits with elastomeric yarns in the structure [17].

The main goal of this study was to develop new knitted fabrics from peat fibres and their combination with widely used fibres such as cotton, wool and Lycra, and to compare selected structural parameters and physical properties, such as the loop length, wale and course spacing and density, the tightness factor, dimensional stability, air permeability, and water adsorption of these new fabrics.

■ Materials and methods

Fabrics knitted from pure peat, cotton and woollen yarns, a peat and woollen yarn combination, three variants of the peat and cotton yarn combination as well as from the yarns combination mentioned, with elastomeric Lycra yarns, were developed for this experimental work. The content of Lycra used is less than 5%. One of the knitted samples, used for comparative analysis, was designed with elastomeric Lycra yarns because at present most knitted products are manufactured with a small amount of elastomeric yarns in order to improve the tensility and elasticity of the knitted garment. All knitted fabrics investigated were produced at JSC "Vegateksa" (Lithuania). The newly developed fabrics are

designated for use in socks, hence pull on/off comfort, provided by elastomeric yarn's elastic extensibility, is very important for such knits.

The fabrics were knitted in a single jersey knitting pattern on a circular 14E gauge one needle-bed knitting machine – Matec Techno New (Italy). The main characteristics of the knitted fabrics developed and investigated are presented in *Table 1*. The relative error of values measured is less than 5%.

All experiments were carried out in a standard atmosphere for testing according to Standard LST EN ISO 139:2005. Structure parameters of the knits, such as the actual loop length and wale and course density, were analysed according to Standard LST EN 14971:2006. The actual loop length was measured by the unknitting method. The pretension of unknitted yarn during the measurement was 0.02 cN/tex. The course and wale density were counted in the length and crosswise directions of the knits over a 10 cm distance and evaluated per 1 cm. The area density M, loop shape factor C and tightness factor TF were calculated according to *Equations (1), (2), (3)*.

$$M = P_w \cdot P_c \cdot l \cdot T \cdot 10^{-2} \qquad (1)$$

where P_w is the wale density in cm^{-1}, P_c the course density in cm^{-1}, l the loop

Table 1. Characteristics of knitted fabrics investigated.

Samples code	Yarn fibrous composition and linear density, tex	Wale and course density, cm⁻¹		Actual loop length *l*, mm	Wale spacing *A*, mm	Course spacing *B*, mm	Loop shape factor, *C*	Area density *M*, g/m²	Tightness factor *TF*, tex¹ᐟ²/cm
		P_w	P_c						
4P	Peat, 60×1×4	4.0	4.5	11.4	2.50	2.22	0.89	492.48	1.36
2W	Wool, 111×1×2	3.9	4.4	11.2	2.56	2.27	0.89	384.38	1.26
8C	Cotton, 29.4×1×8	3.8	4.4	11.3	2.63	2.27	0.86	444.38	1.36
2P + 1W	Peat + Wool, 60×1×2 + 111	4.0	4.4	11.2	2.50	2.27	0.91	433.66	1.32
1P + 6C	Peat + Cotton, 60 + 29.4×1×6	3.9	4.2	11.5	2.56	2.38	0.93	445.31	1.34
2P + 4C	Peat + Cotton, 60×1×2 + 29.4×1×4	3.9	4.2	11.4	2.56	2.38	0.93	443.68	1.35
3P + 2C	Peat + Cotton, 60×1×3 + 29.4×1×2	3.9	4.3	11.5	2.56	2.33	0.91	460.54	1.34
4P + L	Peat + Lycra, 60×1×4 + 8.6	4.2	4.9	11.2	2.38	2.04	0.86	573.01	1.41
1P + 6C + L	Peat + Cotton + Lycra, 60 + 29.4×1×6 + 8.6	4.0	4.9	11.2	2.50	2.04	0.82	537.82	1.40
2P + 4C + L	Peat + Cotton + Lycra, 60×1×2 + 29.4×1×4 + 8.6	4.0	4.8	11.2	2.50	2.08	0.83	529.43	1.40
3P + 2C + L	Peat + Cotton + Lycra, 60×1×3 + 29.4×1×2 + 8.6	4.0	4.8	11.2	2.50	2.08	0.83	532.01	1.40
2P + 1W + L	Peat + Wool + Lycra, 60×1×2 + 111 + 8.6	4.2	4.5	11.1	2.38	2.22	0.93	479.58	1.36

Table 2. Characteristics of washed knitted fabrics investigated.

Samples code	Yarn fibrous composition and linear density, tex	Wale and course density, cm⁻¹		Actual loop length *l*, mm	Wale spacing *A*, mm	Course spacing *B*, mm	Loop shape factor, *C*	Area density *M*, g/m²	Tightness factor *TF*, tex¹ᐟ²/cm
		P_w	P_c						
4P	Peat, 60×1×4	4.2	5.8	11.2	2.38	1.72	0.72	654.80	1.38
2W	Wool, 111×1×2	3.8	4.8	11.0	2.63	2.08	0.79	401.28	1.29
8C	Cotton, 29.4×1×8	3.7	5.6	11.0	2.70	1.79	0.66	536.07	1.39
2P + 1W	Peat + Wool, 60×1×2 + 111	3.9	5.4	11.0	2.56	1.85	0.72	509.65	1.35
1P + 6C	Peat + Cotton, 60 + 29.4×1×6	3.8	5.7	11.2	2.63	1.75	0.67	537.49	1.37
2P + 4C	Peat + Cotton, 60×1×2 + 29.4×1×4	3.8	5.8	11.2	2.63	1.72	0.66	586.51	1.38
3P + 2C	Peat + Cotton, 60×1×3 + 29.4×1×2	4.0	5.6	11.2	2.50	1.79	0.71	599.10	1.38
4P + L	Peat + Lycra, 60×1×4 + 8.6	4.0	6.7	11.0	2.50	1.49	0.60	732.87	1.43
1P + 6C + L	Peat + Cotton + Lycra, 60 + 29.4×1×6 + 8.6	3.9	6.7	11.0	2.56	1.49	0.58	704.20	1.42
2P + 4C + L	Peat + Cotton + Lycra, 60×1×2 + 29.4×1×4 + 8.6	3.9	6.5	11.0	2.56	1.54	0.60	686.53	1.43
3P + 2C + L	Peat + Cotton + Lycra, 60×1×3 + 29.4×1×2 + 8.6	3.9	6.4	11.0	2.56	1.56	0.61	679.26	1.43
2P + 1W + L	Peat + Wool + Lycra, 60×1×2 + 111 + 8.6	4.1	5.6	11.0	2.44	1.79	0.73	577.35	1.37

length in mm, *T* the yarn linear density in tex, and *l* is the actual loop length in mm.

$$C = \frac{B}{A} \qquad (2)$$

$$TF = \frac{\sqrt{T}}{l} \qquad (3)$$

Various authors present different values of the loop shape factor *C* of weft knitted fabric with optimal loop density. According to Chamberlain's model, *C* for single jersey structures varies in the range 0.58-0.87.

In order to investigate the main comfort properties, the dimensional stability, permeability to air and static water adsorption were measured in this work.

The dimensional stability of knitted fabrics, i.e. the shrinkage value after washing and drying, was investigated according to Standard ISO 26330:1993. After washing for (10±0.5) min at (40±2)°C temperature and 3 g/l washing powder concentration of the washing solution, the samples were rinsed three times at (20±2)°C temperature. The duration of each rinse was (1±0.1) min. The rinsed samples were spun (frequency of revolution: 1000 min⁻¹) for (1±0.1) min and dried for 24 h on a smooth surface. The shrinkage value *λ* was determined by the following *Equation (4)*:

$$\lambda = \frac{L - L_0}{A} \cdot 100 \qquad (4)$$

Where, *λ* – shrinkage in %, L_0 the dimension of the sample before washing and drying in mm, and *L* is the dimension of the sample after washing and drying.

Air permeability tests of the knitted fabrics investigated were conducted according to Standard EN ISO 9237:1997 with equipment L14DR (Karl Schroder KG, Germany) using a head area of 5 cm² and pressure difference of 100 Pa. 20 tests per sample were performed. The air permeability *R* was determined according to the following *Equation (5)*:

$$R = \frac{D}{A} \cdot 167 \qquad (5)$$

where *R* is the air permeability in dm³/(m²s), *D* the average air flow rate in dm³/min, and *A* is the sample operative area in 5 cm², 167 – coefficient.

The static water absorption was measured according to the BV S1008 'Bureau Veritas Consumer Products Service" internal test method. The samples were conditioned in laboratory conditions, cut into pieces (10×10) cm and weighed. After that the samples were kept for 1 min in distilled water. After being removed from the water, they were hung for 3 min to remove excess water, and the weight of the wet samples was measured. The static water adsorption S_w was calculated using the following formula:

$$S_w = \frac{m_w - m_d}{m_d} \cdot 100 \qquad (6)$$

Where, S_w is the static water absorption in %, m_w the weight of the wet sample in g, and m_d is the weight of the dry sample in g.

■ Results and discussions

Structural analysis

Structural parameters of newly developed fabrics knitted in a single jersey pattern from peat fibre and its combinations with cotton, woollen and Lycra yarns were calculated and compared (results of structural measurements and calculations are presented in *Table 1*). The new knitted fabrics with peat fibre have a structure optimal for use, as confirmed by the tightness factor *TF* values: 1.26÷1.41 tex¹ᐟ²/cm (according to Munden, Knapton and Konopasek investigations the optimal *TF* value is in the range 1.10÷1.90 tex¹ᐟ²/cm). The loop length of the knits with different fibrous compositions is very similar (11.1÷11.5 mm) in all variants. However, the geometry of the loop (defined by wale *A* and course *B* spacing) in different variants of knits varies in wider margins. The course *B* and wale *A* spacing are important structural factors as they are directly related to the loop geometry and course and wale densities, which represent the changes in stitch shape using various yarns. On the other hand, the structural parameters such as course and wale spacing and density are one of the main factors that influence the majority of physical properties of a knit. Com-

paring knits with Lycra elastomeric yarn to those without Lycra yarn, the course spacing is up to 12% lower, the wale spacing up to 8% lower, and the loop length is only up to 2.5% lower than in the fabrics without Lycra yarn.

Shrinkage

Shrinkage is one of the most serious problems of fabrics from natural fibres, especially in single jersey knitted fabrics because of the lowest number of inter-dependent relations between the yarns bent into loops [8]. Thus the single jersey structure is flexible, allowing changes in loop form and width-height dimensions.

Dimensional changes in the fabrics investigated were calculated according to the *Equation (4)*. Results of fabrics shrinkage after washing and drying are presented in *Figure 1*. As was expected, all knitted samples shrunk in thr lengthwise direction at a high level because it was the first wet treatment after knitting. The lowest shrinkage value in the lengthwise direction was obtained for the woollen knitted sample, whereas knits from a woollen and peat yarn combination reached shrinkage values closer to other cellulosic knits made from peat, cotton yarns and their combinations. In the transverse direction, the fabrics investigated changed their dimensions noticeably less (up to 3-5%). And only the pure peat fibre knit and peat/cotton knit, with the highest amount of peat fibre yarns, shrank in the transverse direction. Dimensions of all other samples investigated elongated in the transverse direction, typical for single jersey weft knitted fabrics with high (more than 10%) shrinkage in the lengthwise direction [11].

Structural characteristics of the knitted fabrics investigated after the washing and drying cycle are presented in *Table 2*. The wale and course density as well as the wale and course spacing change according to dimensional variation in the lengthwise and transverse direction, respectively. However, the loop length shortened only up to 3% after washing and drying, and differences in the loop length among all knits investigated decreased. It means that dimensional changes occurred not only because of the relaxation of tensile stresses but also due to the relaxation of other deformations, such as bending or torsion. Values of the tightness factor *TF* values vary in the range 1.26÷1.41 tex$^{1/2}$/cm.
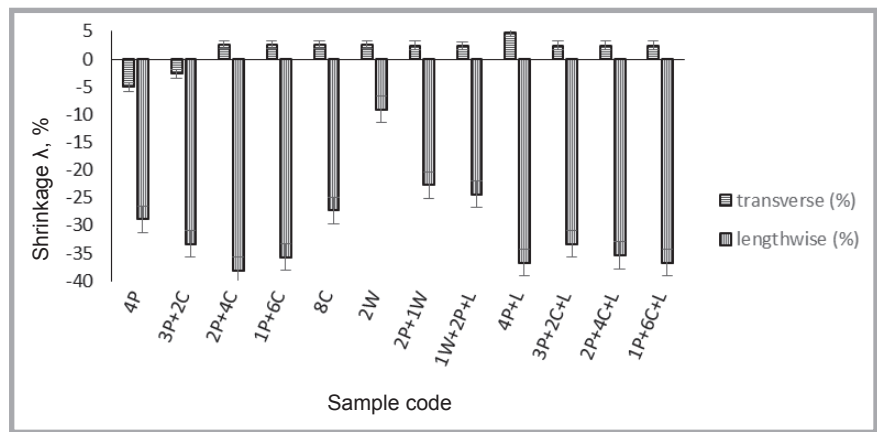

Figure 1. Shrinkage of knitted fabrics investigated after washing and drying cycle.

Table 3. Air permeability of knitted fabrics investigated before and after washing and drying.

Sample code	Air permeability R, dm³/(m²s)		Coefficient of variation, %	
	Before washing	After washing	Before washing	After washing
4P	915.2	314.0	1.83	5.35
2W	1118.9	679.7	1.53	3.66
8C	961.9	252.2	3.49	8.10
1P + 6C	734.8	220.4	3.61	7.62
2P + 4C	820.0	275.6	3.10	5.38
3P + 2C	893.5	319.0	2.68	3.76
1W + 2P	1067.1	472.6	2.38	2.59
4P + L	624.6	138.6	4.62	5.67
1W + 2P + L	587.8	215.4	3.40	7.91
1P + 6C + L	384.1	95.9	4.46	7.73
2P + 4C + L	457.6	100.2	3.43	0.90
3P + 2C + L	512.7	108.6	3.19	7.89

Air permeability

Air permeability of knitted fabrics depends on the loop length and loop density in the knit and is strong related to yarn characteristics, such as the yarn type, twist level and linear density of the yarn, as well as the number of yarns in the loop [8, 9, 11, 12].

Results for the air permeability of the knitted fabrics investigated before and after washing and drying are presented in *Table 3*. The air permeability of the pure cotton fibre knit is 5% higher than for the pure peat fibre knit, because of the smoother, less hairy surface of cotton yarn (see in *Figure 2*, see page 28). However, this difference in permeability to air is not significant. The air permeability of the pure woollen knit has the highest value (14% higher than for the pure cotton fibre knit and 18% higher than for the pure peat fibre knit), although the linear density of woollen yarns in this knit is the same as in cotton and peat fibre knits, as well as the loop length in all knits being similar. One more interesting point observed was that the air permeability of

knits made from the peat and cotton yarn combination is lower than for pure cotton or peat fibre knits. This leads to the conclusion that the different behaviour of peat and cotton yarns during loop formation (for the reason of different friction, rigidity, etc.) is determined a little bit by the different geometry of the combined peat and cotton yarns in the loop, and this, in turn, induces a higher surface coverage by the combined yarn as well as lower porosity of such a knit.

Our results obtained confirm the statement, also made by other researchers [8, 14], that the air permeability of knits significantly decreases when using elastomeric yarns in a plated structure, even when the amount of elastomeric yarn in the knit is very low, i.e. less than 3-5%. In our case, the air permeability of knits plated with Lycra yarn decreased by 43-48% compared with knits without Lycra yarn. Due to the elastomeric yarn knitted structure becoming tighter, the geometry of the knitted loop changes, and the wale and course spacing as well as the porosity of the knit decrease.
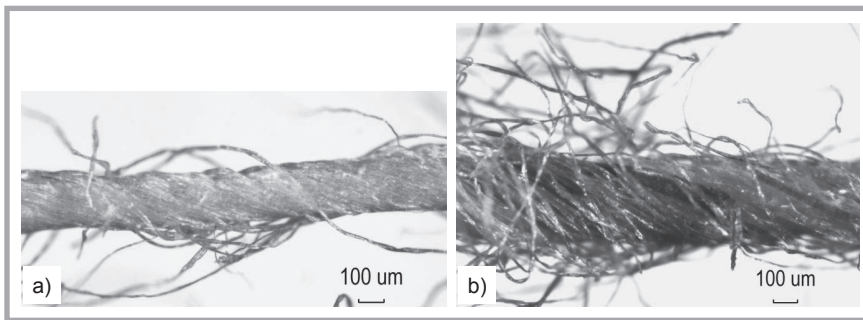
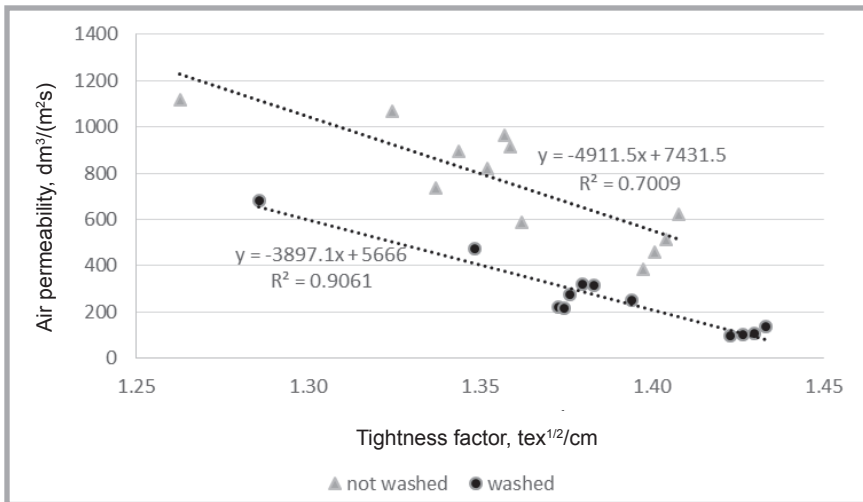*Figure 2. Optical view of cotton yarn (a) and peat yarn (b).*

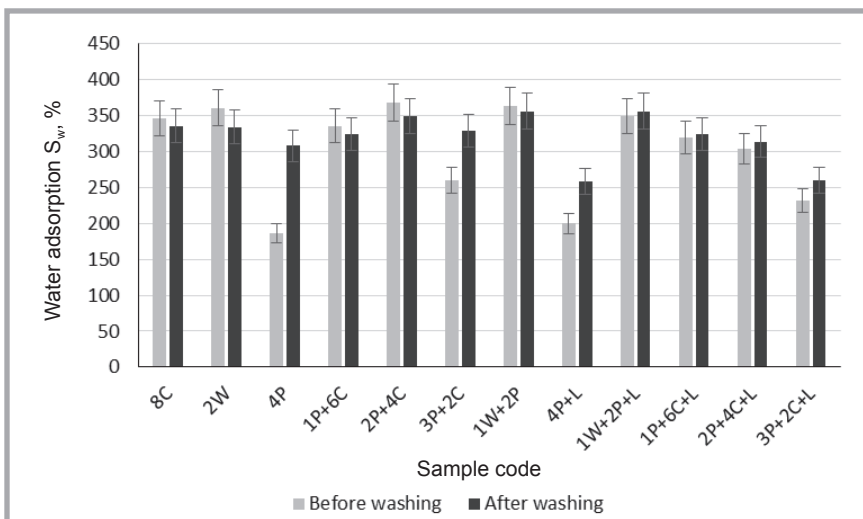*Figure 3. Dependence of permeability to air of knits on tightness factor.*

Figure 4. Static water adsorption of knitted fabrics investigated.

The significant influence of structural changes in the knits after washing and drying on their permeability to air is evident in *Table 3*. Whereas the shrinkage after the washing and drying cycle was very high, especially in the lengthwise direction, the air permeability of the washed knitted samples crucially decreased, which obviously correlates with the shrinkage level. The shrinkage of the woollen knit has got the lowest value (less than -10%), and accordingly the decrease in air permeability of this fabric is the lowest – 1.6 times lower than before washing. The shrinkage of knits of pure peat, cotton fibre yarns and their combinations was more than -25%, and accordingly the air permeability of these fabrics decreased by even 2.8-3.8 times. As shrinkage values of peat/cotton/ly-

cra blended knits were more than -30%, the air permeability of these fabrics decreased even more – 4.0-4.7 times. Such a crucial drop in permeability to air arises not only for the reason of structure tightening through shrinkage but also because of the felting of elementary fibres on the surface of the yarns as well as on the surface of the knit. This fact is proved by the air permeability dependence on the tightness factor (presented in *Figure 3*).

As presented in *Figure 3*, knits with the same tightness factor have up to 2 times or even higher air permeability. The tightness factor indicates surface covering by the yarn bent into a loop and is correlative only with the loop length (not evaluating the different geometry of the loop) and linear density of the yarn (not evaluating the surface's smoothness/roughness). Because of the felting of the knit's surface during the washing process, the coefficient of determination of the dependency presented for washed knits is higher than for the unwashed knits. The felting of elementary fibres on the surface of the yarn decreases the porosity of the knit's surface as well as air permeability.

Adsorption

The ability to adsorb water is an important physical property that can have a significant impact on the comfortability and functionality of clothing. All natural fibres are more or less hydrophilic, with peat fibre being no exception. Results for water adsorption of the knitted fabrics investigated are presented in *Figure 4*, from which it can be seen that pure peat fibre knits and combined peat/cotton fibre knits of variants 3P+2C and 3P+2C+L (with the highest amount of peat fibre) demonstrate the lowest values of static water adsorption. In the majority of cases, the difference in static water adsorption values before and after washing varies in the ranges of errors, although the adsorption values of the unwashed pure peat fibre knit or knit plated with Lycra yarn and their combination with the lowest amount of the cotton yarns are significantly lower than of the same knits after the washing cycle. This could be because of the additional chemicals used in peat yarn production that reduce the hydrophilicity of the yarns and can be removed during washing. After washing, the static water adsorption of peat fibre knits remains the lowest; however, this difference is not so high as before the washing.

Conclusions

The newly developed fabrics knitted of peat fibre yarns and their combination with cotton, woollen and elastomeric Lycra yarns have the optimal structure (as confirmed by $TF = 1.26 \div 1.41$ tex$^{1/2}$/cm). The loop length in all the variants is very similar, however the geometry of the loop differs in wider ranges, especially in the knits plated with elastomeric Lycra yarns. It demonstrates the the influence of the raw material of the yarn on the loop geometry as well as on structural parameters, such as wale and course spacing as well as loop density in the course and wale directions.

All the knitted fabrics investigated shrunk in the lengthwise direction at a high level – up to -38%, due to being the first wet treatment after knitting. However, in the transverse direction the fabrics investigated changed their dimensions noticeably less – up to 5%. The shrinkage of the pure peat and pure cotton knits is similar, with the lowest shrinkage value being reached by the woollen knit; however, knits from the woollen and peat yarn combination reached shrinkage values closer to those for knits of peat or cotton fibres and their combinations.

After washing and drying, the wale and course density as well as the wale and course spacing changeaccording to dimensional changes; however, the loop length decreased only up to 3%. It demonstrates that dimensional changes occurred not only because of the relaxation of tensile stresses but also because of the relaxation of such yarn deformations as bending or torsion, i.e. not only the loop length but also its orientation in a three-dimensional space was changed.

The air permeability of the pure peat fibre knit is only 5% less than for the pure cotton fibre knit because of the smoother, less hairy surface of cotton yarn. However, the air permeability of knits made from the peat and cotton yarn combination is lower than for the pure cotton or peat fibre knits as the surface covered by the combined yarn is higher (because of the different geometry of the combined peat and cotton yarns in the loop) and the porosity lower. The air permeability of the pure woollen knit is 14-18% higher than for the pure cotton and pure peat fibre knits, although the loop length in all knits is similar. The permeability to air of the knits plated with elastomeric Lycra yarn decreased by 43-48% compared with those without Lycra yarn as, due to the elastomeric yarn, the wale and course spacing as well as the porosity of the knit decreases.

Structural changes in the knits after washing and drying significantly decreased their air permeability – up to 4.7 times. A decrease in air permeability after washing arises not only due to the structure's tightening but also because of the felting of elementary fibres on the surface of the yarns as well as on that of the knit. This fact is proven by the air permeability dependence on the tightness factor – knits with the same tightness factor have up to 2 times or even higher permeability to air.

The static water adsorption of pure peat fibre knits and combined peat/cotton fibre knits with the highest amount of peat fibre is lower than for woollen and cotton knits; however, after washing, the static water adsorption of peat fibre knits remains the lowest, but this difference is not so significant as before the washing.

Thus the results obtained demonstrate that the behaviour of peat fibre knits differ from those of other natural fibres because of the different physical and mechanical properties of the fibres. Therefore the properties of knits of the newly developed fibres cannot be predicted using other widely investigated natural fibre knits despite the fact that comparable ones are made under the same technological conditions. This was also proven in [18], in which a comparable analysis of the behaviour of man-made fibre knits and those of other cellulosic (cotton and viscose) fibres is given.

References

1. Kozłowski R. State and Future Prospects of Natural Fibres. Magic world of textiles. In 7th international textile, clothing & design conference, October 5-8, 2014, Dubrovnik, Croatia: book of proceedings/ University of Zagreb. 2014; 93-97.
2. Fritz E. The Curent Importance of Peat Textiles. *Journal of Anthroposophical Medicine* 1995; 12, 4: 1-4.
3. Suni S, Kosunen A-L, Hautala M, Pasila A and Romantschuk M. Use of a by-product of peat excavation, cotton grass fibre, as a sorbent for oil-spills. *Marine Pollution Bulletin* 2004; 49: 916-921.
4. Uçar N and Yilmaz T. Thermal Properties of 1x1, 2x2, 3x3 Rib Knitted Fabrics. *Fibres & Textiles in Eastern Europe* 2004; 12, 3(47): 34-38.
5. Abramavičiūtė J, Mikučionienė D and Čiukas R. Static water absorption of knits from natural and textured yarns. *Fibres & Textiles in Eastern Europe* 2011; 19, 3(86): 60-63.
6. Ahsan N, Tanveer H, Faheem A and Sajid F. Effect of Knitting Parameters on Moisture Management and Air Permeability of Interlock Fabrics. *AUTEX research Journal* 2014; 14 (1): 39-46.
7. Kiekens P, Van der Burght E, Kny E, Tamer U and Milašius R. Functional Textiles – from Research to Development. *Autex Research Journal* 2014; 14, 4: 219-225.
8. Çoruh E. Optimization of Comfort Properties of Single Jersey Knitted Fabrics. *Fibres & Textiles in Eastern Europe* 2015; 23, 4(112): 66-72.
9. Safdar F, Hussain T, Nazir A and Iqbal K. Improving Dimensional Stability of Cotton Knits Through Resin Finishing. *Journal of Engineered Fabrics & Fibers (JEFF)* 2014; 9, 3: 28-35.
10. Čiukas R, Tvarijonavičienė B and Mikučionienė D. Estimating the linear density of fancy ribbon-type yarns and the structure indices of fabrics knitted from them. *Fibres & Textiles in Eastern Europe* 2006; 14, 4(58): 41-43.
11. Tvarijonavičienė B, Mikučionienė D and Čiukas R. Influence of knitting process conditions and washing on tensile characteristics of knitted ribbon yarns. *Fibres & Textiles in Eastern Europe* 2005; 13, 4(52): 74-77.
12. Kalkanc M and Kurumer G. Investigation of Dimensional Changes during Garment Production and Suggestions for Solutions. *Fibres & Textiles in Eastern Europe* 2015; 23, 3(111): 8-13.
13. Bivainytė A, Mikučionienė D. Influence of shrinkage on air and water vapour permeability of double-layered weft knitted fabrics. *Materials Science (Medžiagotyra)* 2012; 18 (3): 271-274.
14. Abramavičiūtė J, Mikučionienė D and Čiukas R. Structure properties of knits from natural yarns and their combination with elastane and polyamide threads. *Materials Science (Medžiagotyra)* 2011; 17 (1): 43-46.
15. Benltoufa S, Fayala F, Cheikhrouhou M, M and Ben Nasrallah S. Porosity determination of jersey structure. *AUTEX Research Journal* 2007; 7 (1): 63-69.
16. Zhu G, Kremenakova D, Wang Y, Militky J and Mishra R. Study on air permeability and thermal resistance of textiles under heat convection. *Textile Research Journal* 2015; 85, 16: 1681-1690.
17. Bivainytė A, Mikučionienė D. Investigation on the Dynamic Water Absorption of Double-Layered Weft Knitted Fabrics. *Fibres & Textiles in Eastern Europe* 2011; 19, 6(89): 64-70.
18. Mikučionienė D, Arbataitis E. Comparative Analysis of the Influence of Bamboo and Other Cellulose Fibres on Selected Structural Parameters and Physical Properties of Knitted Fabrics. *Fibres & Textiles in Eastern Europe* 2011; 19, 3(86): 60-63.