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Study of the influence of weft yarn tension on the properties of woven-knitted material

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Abstract. The relevance of the study is determined by the practical need to reduce weft yarn consumption while preserving the structural stability, tensile performance and commodity quality of a material that combines woven longitudinal strips with looped weft connections. The purpose of the article was to determine the influence of weft yarn tension on the physical, mechanical and structural properties of woven-knitted textile material article 10c2 produced on a Metap-160 laboratory machine. Polyester warp yarns with a linear density of 24.5 tex and multifilament polyester weft yarns with a linear density of 8.4 tex were used for the experimental samples. Weft tension was varied from 9.2 to 14.8 cN per yarn by changing the number and position of the regulating weights on the levers of the weft regulator. The study evaluated breaking force and breaking elongation in the warp and weft directions, the breaking characteristics of weft yarns withdrawn from the material, the projected length of the weft yarn in the plane of the material, the actual weft consumption per insertion, the produced width, the width of an individual woven-knitted strip, thickness, abrasion resistance, air permeability and the stability of the phase structure of the woven areas. It was established that within the investigated interval an increase in weft tension does not cause critical deterioration of the main performance indicators. The projected weft length decreased from 13.38 to 13.11 mm per insertion, the actual weft consumption from 15.28 to 14.81 mm per insertion, and the coefficient of weft consumption from 1.142 to 1.130, while the produced width decreased from 164.8 to 160.4 cm. The obtained relationships substantiate a multi-criteria approach in which weft tension is applied as a resource-saving factor only in combination with dimensional control of the material

Keywords: weft consumption; looped connection; Metap-160; air permeability; abrasion resistance; resource saving

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Introduction

Modern textile production increasingly requires structural solutions that combine stable mechanical behaviour with economical use of raw materials. For fabrics made from synthetic filament yarns, a small saving of yarn length per insertion becomes substantial when it is multiplied by industrial production lengths. The problem, however, is not purely economic. Excessive yarn consumption changes fabric geometry and mass per unit area and can influence air permeability, bending behaviour and dimensional stability, whereas an excessive reduction of the yarn reserve generates local stresses, unstable loop formation and narrowing of the material. Woven-knitted materials are particularly sensitive to this balance, because in them the weft simultaneously fills the shed inside the longitudinal woven strips and forms the loop columns that join those strips into a continuous sheet. The technological task is therefore to identify a controlled range of weft tension that saves raw material without creating defects or reducing consumer quality.

Recent experimental work has clarified how the parameters of the weft system govern fabric behaviour. M. Ayele *et al.* (2024) applied a full factorial design to plain woven fabric and showed that weft tension, together with weft yarn type and weft density, alters the porous structure of the fabric and consequently its thermal resistance, thermal conductivity and air permeability. The same research group (Kassaw & Ayele, 2024) established that an increase in weft and warp tension raises the surface roughness of the fabric and reduces its drape, which means that tension has to be treated as a quality-forming variable and not merely as a machine setting. S. Vasile *et al.* (2024) compared hemp-inen fabrics of different weaves and weft types and found that the tensile properties remained statistically unchanged when hemp weft replaced flax, while air permeability and moisture management differed significantly; this demonstrates that different groups of properties do not respond uniformly to one constructional change. N. Mandre *et al.* (2021) reported that a higher number of weft yarns per centimetre reduces the air permeability of denim fabrics but simultaneously improves their abrasion resistance, which again indicates a trade-off rather than a uniform improvement. Earlier, M. Maqsood *et al.* (2016) and M. Umair *et al.* (2016) modelled the influence of weave structure and thread density on the mechanical and comfort properties of woven fabrics and confirmed the statistical significance of these constructional factors.

For looped structures the closest analogy is provided by Ukrainian research on warp-knitted fabrics with laid-in weft. L. Melnyk *et al.* (2016) showed that the variant of the weft filling yarn changes the structural parameters and mechanical properties of warp-knitted fabric. In a later study O. Kyzymchuk *et al.* (2023) demonstrated that the type of weft yarn and the threading order of the additional yarn system determine the elasticity, dimensional stability and thermal comfort of elastic warp-knitted bands. These works consistently confirm that a yarn laid into a looped structure is a full participant in structure formation rather than a passive filling.

At the same time, three questions remain unresolved in the cited studies. First, the effect of tension has been quantified for a weft that performs a single function inside a woven or a knitted structure, but not for a weft that simultaneously forms the woven and the looped areas of one material. Second, the yarn length actually incorporated into the three-dimensional looped connection has not been separated from the yarn length visible in the plane of the material, so raw-material economy is estimated from a projection rather than from real consumption. Third, the influence of weft tension on the produced width – the parameter that in practice limits any tension-based saving – has not been quantified for woven-knitted materials formed on machines of the Metap type.

Accordingly, this article sought to clarify how variations in weft yarn tension, applied during the formation of woven-knitted material article 10c2 on a Metap-160 laboratory machine, translate into measurable changes in its mechanical, structural and dimensional behaviour. To achieve this purpose, three tasks were set: (1) to establish how weft tension within the interval of 9.2-14.8 cN per yarn affects the tensile characteristics of the material and of the weft yarns withdrawn from it; (2) to determine the projected and the actual weft consumption per insertion, the coefficient of weft consumption and the accompanying changes in the width of the material and of an individual woven-knitted strip; (3) to substantiate the criteria for selecting a tension regime that combines raw-material economy with the dimensional and commodity requirements for the material.

Materials and Methods

The experimental research was conducted in 2025 on a Metap-160 laboratory machine (Elitex, Czech Repuplic). The object of the study was woven-knitted textile material article 10c2, formed as a system of longitudinal woven strips joined across the width of the material by loop columns of weft yarns. Polyester yarns with a linear density of 24.5 tex were used in the warp system, and multifilament polyester yarns with a linear density of 8.4 tex were used in the weft system. The setting contained 3,498 warp yarns and 317 weft yarns; the nominal density of the material was 22 yarns/cm in the warp direction and 44 yarns/cm in the weft direction. The investigated weft tension range was 9.2-14.8 cN per yarn. These parameters were selected because the material is formed within this interval without visible defects, while the differences in yarn consumption remain measurable.

Weft yarn tension was regulated by changing the number of weights and their position on the levers of the weft regulator. The operating principle of the regulator is based on the balance of moments acting on the movable unit of the weft beam: on one side of the system a torque is created by the tension of the weft yarns, and on the other side the system is loaded by the gravity force of the weft beam with the roller and by the moments created by the regulating weights. Changing the mass or the lever arm of the weights makes it possible to establish a different average tension of the weft yarns. In this research the regulator was used to obtain a sequence of six tension regimes within the investigated interval.

Before testing, the samples were conditioned in the standard atmosphere in accordance with ISO 139:2005 (2005). The breaking force and breaking elongation of the material in the warp and weft directions were determined by the strip method in accordance with ISO 13934-1:2013 (2013), and the breaking characteristics of the weft yarns withdrawn from the material in accordance with ISO 2062:2009 (2009). Thickness was measured in accordance with ISO 5084:1996 (1996), air permeability in accordance with ISO 9237:1995 (1995) and abrasion resistance by the Martindale method in accordance with ISO 12947-2:2016 (2016). The phase structure of the woven areas was assessed qualitatively on enlarged images of the material.

The projected length of the weft yarn was measured on enlarged images of the material structure and characterises the length of the yarn path visible in the plane of the textile sheet. Because woven-knitted material has a three-dimensional structure, this projection does not represent the whole yarn length incorporated into the looped connections. To determine the actual weft consumption, two adjacent strips with the loop column between them were cut from the material so that the weft yarns could be withdrawn with minimal disturbance of their shape. The length of the withdrawn weft yarns was measured on a section corresponding to 100 insertions and recalculated per one insertion. This procedure makes it possible to separate the geometric projection from the actual consumption.

To interpret the difference between the projected and the actual weft length, the coefficient of weft consumption was used:

$$K_{wc} = l_a / l_p, \tag{1}$$

where K_{wc} – the coefficient of weft consumption; l_a – the actual weft consumption per insertion, mm; l_p – the projected length of the weft yarn in the plane of the material, mm. A value above unity indicates that an additional yarn length is stored in the three-dimensional looped structure, and a decrease of the coefficient with increasing tension is interpreted as a more compact placement of the weft yarn in the material.

Each indicator was determined in five replicate measurements ($n = 5$) for every tension regime. The results are presented as arithmetic means; the standard deviation and the 95% confidence interval are given in the notes to the figures and tables. The significance of the differences between the tension regimes was assessed by one-way analysis of variance (ANOVA) with Tukey's HSD post-hoc test at a significance level of $p \leqslant 0.05$. The measured indicators were combined into four groups, so that a tension regime could be assessed simultaneously by its structural, economic, mechanical and commodity consequences (Table 1).

Table 1. *Methodological matrix of the measured indicators*

Group of indicators	Measured / calculated indicator	Purpose of evaluation
Structural	Produced material width; width of an individual woven-knitted strip; arrangement of the strips	To control dimensional stability and the risk of narrowing
Yarn consumption	Projected weft length; actual withdrawn weft length; coefficient of weft consumption K_{wc}	To estimate raw-material economy and the yarn reserve stored in the structure
Mechanical	Breaking force and breaking elongation in the warp and weft directions; breaking force of the withdrawn weft yarns	To verify that resource saving does not reduce strength
Commodity quality	Thickness, air permeability, abrasion resistance, phase structure of the woven areas	To confirm the preservation of use-related properties
Technological decision	Comparison of all indicators across the tension regimes	To select a balanced tension range instead of a regime based on a single property

Source: *compiled by the authors*

Such a combination of groups was applied because a tension regime cannot be considered rational if it saves yarn but causes unacceptable narrowing or a loss of performance. The experimental design did not aim to replace a full industrial optimisation; its purpose was to establish the direction and the practical significance of the changes in the properties of the material when weft tension is varied within a technologically acceptable interval.

Results and Discussion

Initially, the analysis focused on tensile characteristics. Figure 1 presents the dependence of the breaking force and the breaking elongation of the woven-knitted material and of the withdrawn weft yarns on the weft yarn tension. The curves show no abrupt decrease in the strength of the material as tension increases within the investigated range. The breaking force in the weft direction rises over the first part of the interval, reaches a maximum in the region of 9.9-10.7 cN per yarn and then settles at a level that remains above the value recorded at the lowest tension. The breaking force in the warp direction behaves in the same manner but with a considerably smaller amplitude, which is expected because the warp system is not directly affected by the weft regulator and reacts only through the change in the geometry of the strips. The breaking force of the weft yarns withdrawn from the material follows the same pattern, and this is the key argument for the technological admissibility of the interval: if the higher tension damaged the filaments or disturbed loop formation, the withdrawn yarns would lose strength before the material did. The absence of such a loss indicates that the investigated tension values do not exceed the deformation reserve of the polyester weft.

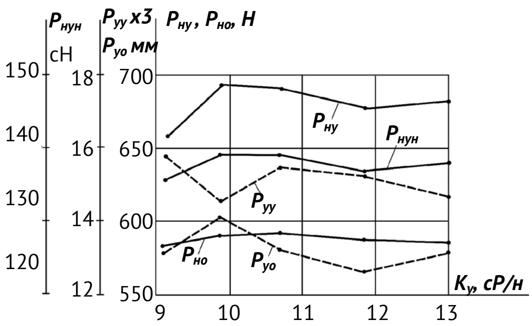

Figure 1. *Tensile characteristics of the woven-knitted material and of the weft yarns as a function of weft yarn tension*

Note: *K_y – weft yarn tension, cN per yarn; $P_{ну}$, $P_{но}$ – breaking force of the material in the weft and in the warp direction, N; $P_{уу}$, $P_{уо}$ – breaking elongation of the material in the weft and in the warp direction, mm ($P_{уу}$ – plotted with a scale factor of 3); $P_{нун}$ – breaking force of the weft yarns withdrawn from the material, cN. Each point is the arithmetic mean of measurements (n = 5); the standart deviation did not exceed 4% of the mean value*

Source: *developed by the authors on the basis of the experimental data*

The behaviour of the elongation curves is less monotonic. Both the weft-wise and the warp-wise breaking elongation pass through a local extremum in the region of 10-11 cN per yarn and then decrease gradually, the weft-wise elongation decreasing more noticeably. This is consistent with the structural role of the weft in the investigated material: elongation in the weft direction is realised mainly by straightening the loops of the connections between the strips, so a reduction of the loop reserve reduces the deformation capacity of the structure before it reduces its strength. The practical conclusion is that elongation, not strength, is the first indicator to react to an increase in tension, and it is therefore elongation that should be monitored when the interval is extended beyond the values investigated here. The most pronounced changes were found for weft yarn consumption and for the width parameters (Fig. 2).

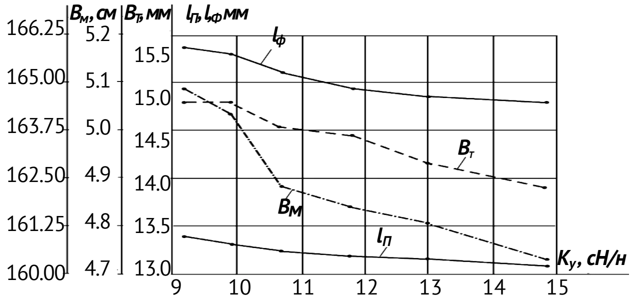

Figure 2. *Width parameters of the material and weft yarn consumption as a function of weft yarn tension*

Note: *K_y – weft yarn tension, cN per yarn; $B_м$ – width of the produced material, cm; B_m – width of an individual woven-knitted strip, mm; $l_п$ – projected length of the weft yarn per insertion, mm; $l_ф$ – actual weft consumption per insertion, mm. Each point is the arithmetic mean of measurements (n = 5); the standard deviation did not exceed 3% of the mean value*

Source: *developed by the authors on the basis of the experimental data*

All four curves in Figure 2 decrease monotonically, but their shapes differ. The projected weft length falls from 13.38 to 13.11 mm per insertion, that is by 0.27 mm or approximately 2.02%, and its curve flattens after 11 cN per yarn: the yarn path visible in the plane of the material approaches a geometric limit determined by the spacing of the strips and can no longer be shortened by tension alone. The actual withdrawn length falls from 15.28 to 14.81 mm per insertion, that is by 0.47 mm or approximately 3.08%, and its decrease is steepest in the region of 9.9-11.8 cN per yarn. The difference between the two curves is exactly the yarn reserve stored in the three-dimensional geometry of the loops, and the fact that the actual length decreases by half again as much as the projection shows that it is this reserve, and not the in-plane path, that responds to tension. A saving of 0.47 mm per insertion may seem negligible at the level of a single pick, but at 317 weft yarns per setting it becomes a measurable raw-material factor over industrial production length.

The width curves reveal the cost of that saving. The width of the produced material decreases from 164.8 to 160.4 cm, that is by 4.4 cm or approximately 2.67%, and the width of an individual woven-knitted strip decreases in almost the same proportion, from about 5.03 to about 4.88 mm. The proportional character of these two reductions is informative: the material does not narrow because the strips are drawn closer to one another while remaining unchanged, but because the strips themselves contract as the looped connection tightens. The transverse contraction is thus distributed over the whole width rather than concentrated in the connections, which explains why the arrangement of the strips remains regular and why the phase structure of the woven areas was assessed as stable throughout the interval. It also explains the shape of the width curve: the steepest fall of the material width coincides with the steepest fall of the actual weft consumption, in the region of 9.9-11.8 cN per yarn, confirming that both effects have a single structural cause. The summarised influence of weft tension on the measured indicators is given in Table 2.

Table 2. *Influence of weft yarn tension on the indicators of the woven-knitted material*

Indicator	Lower tension (9.2 cN/yarn)	Higher tension (14.8 cN/yarn) / direction of change
Projected weft length in the plane of the material, mm per insertion	13.38	13.11; decrease by 0.27 mm (about 2.02%)
Actual weft consumption, mm per insertion	15.28	14.81; decrease by 0.47 mm (about 3.08%)
Coefficient of weft consumption K_{wc}	1.142	1.130; slight reduction of the yarn reserve in the three-dimensional structure
Produced material width, cm	164.8	160.4; decrease by 4.4 cm (about 2.67%)
Width of an individual woven-knitted strip, mm	about 5.03	about 4.88; decrease of about 3.0%
Tensile characteristics of the material and of the withdrawn weft yarns	Reference level	No critical deterioration detected; elongation reacts earlier than breaking force
Thickness, air permeability, abrasion resistance, phase structure	Reference level	No critical changes detected

Note: *the values are arithmetic means of ± standard deviation of five replicate measurements (n = 5).* K_{wc} *– coefficient of weft consumption calculated by formula (1)*

Source: *developed by the authors on the basis of the experimental data*

The coefficient of weft consumption supports the structural interpretation of these changes. At the lower tension it equals 1.142, and at the higher tension it decreases to 1.130, so the yarn reserve stored in the looped connection falls from about 14.2% to about 13.0% of the projected length. The change is moderate, and this is precisely why the tensile characteristics remain stable: the connection retains roughly nine tenths of its initial reserve. A sharper decrease of the coefficient would indicate that the looped connection is losing its capacity to accommodate deformation and is becoming vulnerable to rupture; in the investigated interval the coefficient moves in the direction of rationalisation without reaching that state. This also shows why the coefficient, rather than the absolute saving, is the more informative control parameter: it is dimensionless and therefore transferable to other articles and yarn linear densities.

The observed relationships between weft tension, yarn consumption and width agree with the classical geometric and structural models of textile materials. F.T. Peirce (1937) showed that the quantity of yarn contained in a unit area of fabric is not a free parameter but a function of the geometry imposed during formation, and J.W.S. Hearle (1969) extended this reasoning to show how deformation applied at yarn level is transferred to fabric level; both principles are directly visible in the present data, where a change in the formation tension of a single yarn system reappears as a coordinated change in weft consumption, strip width and produced width. B.K. Behera & P.K. Hari (2010) further noted that the same nominal construction can be realised with different yarn reserves depending on the tension regime, which is exactly the behaviour captured here by the coefficient of weft consumption.

For the looped part of the structure, the results agree with loop-formation theory. D.J. Spencer (2001) described the balance between yarn feeding tension, loop length and dimensional stability, and showed that the length of yarn fed per loop is the primary variable from which the dimensional characteristics of a knitted structure follow; in the investigated material this variable is quantified by the coefficient K_{wc}, which fell from 1.142 to 1.130 as tension increased. The moderate size of that change explains why the tensile characteristics remained stable: the looped connection retained most of its feeding reserve rather than being drawn to its structural limit.

The results for thickness, air permeability, abrasion resistance and the phase structure of the woven areas were treated as control indicators of commodity quality, and none of them changed critically over the investigated interval. The stability of air permeability is consistent with the porosity approach of R.T. Ogulata (2006): the moderate reduction of the weft reserve did not close the inter-yarn voids to a degree that would restrict air passage, because the voids of this material are formed mainly by the spacing between the strips, which remains regular. The stability of abrasion resistance has the same explanation: the surface exposed to the abradant is formed by the woven areas, whose phase structure was preserved. R.B. Büyükbayraktar (2021) reported a comparable pattern for self-stitched double fabrics, in which the stitching arrangement changed air permeability more than tensile strength; the present material shows the same asymmetry, because the looped connection governs consumption and width, while the woven strips govern strength and abrasion resistance.

Compared with the published data, the obtained results are consistent in direction but differ in the object and in the controlled variable. E.K. Çeven *et al.* (2021) reported for drapery fabrics that a higher weft density increases tearing strength but reduces air permeability;

in the present material a comparable compaction of the weft, achieved through tension rather than through density, produced no critical change in either indicator, because compaction here affects the looped connection rather than the woven area that governs strength and permeability. S. Golomeova Longurova *et al.* (2022) showed that the dimensional stability of a woven fabric after processing depends on structural parameters such as yarn density and cover factor; the present material shows that a comparable dimensional response, the narrowing of the produced width, can already be induced during formation by weft tension alone, before any post-treatment is applied. W. Mengie *et al.* (2024) modelled the surface roughness of twill fabric as a function of weft count and weft density and found both factors statistically significant; the present results extend this logic by showing that weft tension, not only weft count or density, is a variable that a producer can use to influence the compactness of the structure, although here the resulting change of width is a stronger practical constraint than any change of surface texture.

In the field of looped textile structures, K. Singal *et al.* (2024) showed that the elasticity of a knitted fabric is an emergent property of the local stitch topology and can be programmed stitch by stitch; the present study extends that logic from the topology of the stitch to the tension with which the yarn is fed into it, and adds a quantitative link between that tension, the actual yarn consumption and the produced width, which stitch-level models do not by themselves provide. X. Ding *et al.* (2024) represented a knitted fabric as a hierarchy of yarn-level loops and showed that fabric-level extensibility is governed by the reserve length stored at each loop, which is the same mechanism that the coefficient K_{wc} quantifies for the looped connections of the present material. S.E. Gonzalez *et al.* (2025) further showed that a knitted structure passes from a soft to a stiff mechanical response once the loops are packed tightly enough to jam against one another; the moderate decrease of K_{wc} observed here, from 1.142 to 1.130, indicates that the investigated tension interval keeps the looped connection well below that jamming threshold, which is consistent with the absence of a critical loss of tensile performance.

From a commodity-science perspective, the key result is the possibility of obtaining raw-material economy without reducing consumer quality. Resource saving in this context is not a simple reduction of material input but a controlled technological decision, the admissibility of which is verified by quality indicators. The study also demonstrates the value of measuring the actual weft consumption instead of relying on the projected yarn length: if only the projection were considered, the saving would be underestimated by about a third, and the yarn stored in the looped structure would remain outside the calculation. The withdrawal method used here can therefore be recommended for other materials in which a yarn reserve in loops or spatial connections is technologically significant. The corresponding practical criteria for choosing a tension regime are summarised in Table 3.

Table 3. *Practical criteria for selecting a weft tension regime*

Criterion	Positive effect of higher tension	Risk / required control
Actual weft consumption	Decrease of the yarn length incorporated per insertion	The saving must be calculated from the withdrawn yarn, not from the projection
Coefficient of weft consumption	More compact placement of the weft in the looped connection	A sharp decrease signals the loss of the deformation reserve of the connection
Material width and strip width	More compact structure	Excessive narrowing may violate the width tolerance of the article
Tensile characteristics	No critical deterioration within the investigated interval	Breaking elongation reacts before breaking force and must be rechecked for other yarns and densities
Air permeability, thickness, abrasion resistance	No critical changes in the tested samples	Porosity-related properties should be monitored whenever the regime is changed

Source: *compiled by the authors on the basis of the obtained results*

Several limitations of the obtained results should be noted. The study covered one material article, one yarn composition and one laboratory machine, and the investigated tension interval, although technologically acceptable for this sample, does not represent the full range of possible settings. The conclusions about the commodity indicators are based on the comparative control of quality characteristics rather than on a complete factorial model of the process, so the interaction between weft tension and other formation parameters remains outside the scope of this work. The stability of the tensile characteristics also should not be transferred automatically to yarns with lower breaking strength, higher friction or elastomeric components, for which the deformation reserve of the looped connection is likely to behave differently.

Taken together, the results show that weft tension in a woven-knitted material performs two coordinated functions: it stabilises yarn feeding and loop formation, and it determines how much yarn is incorporated into the structure. These functions do not conflict within the investigated interval, because the reduction of the yarn reserve remains moderate and the structure retains its strength and its use-related properties. What limits the regime is not the mechanical behaviour of the material but its width, and this is the parameter that converts a purely economic decision into a technological one.

Conclusions

The research established that weft yarn tension is a controllable technological factor of structure formation in woven-knitted material produced on a Metap-160 machine, and that its effect is realised primarily through the yarn reserve stored in the looped connections between the woven strips rather than through the strength of the material. Within the interval of 9.2-4.8 cN per yarn the mechanical and commodity indicators retained the levels required for the article, and the first characteristic to respond to an increase in tension was breaking elongation, which reflects the gradual reduction of the deformation reserve of the loops. Quantitatively, weft consumption, the coefficient of weft consumption and the produced width all responded to the increase in tension in the same direction, with the reduction in actual consumption exceeding that of the visible projection by nearly half again, which confirms that most of the saving comes from the yarn reserve of the loops rather than from the in-plane path of the weft. The accompanying transverse contraction was distributed proportionally across the whole width of the material rather than concentrated at the connections between strips, which is why raw-material saving under increased tension cannot be treated separately from the resulting narrowing of the finished material.

For the production of woven-knitted materials of this type it is advisable to apply a multi-criteria system of tension control in which the regime is selected by combining the actual weft consumption, the coefficient of weft consumption, the width of the material, the tensile characteristics and the group of commodity indicators. Such a system makes it possible to obtain raw-material economy without compromising the confirmed quality of the finished material. Further research will be directed at extending the results to other yarn linear densities and fibre compositions, including yarns with elastomeric components; at constructing a factorial model of the joint influence of weft tension, warp tension and take-up on the yarn reserve of the looped connection; and at verifying the established relationships under industrial conditions, where machine speed, the condition of the yarn packages and the parameters of the production environment can change the actual tension profile.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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Дослідження впливу натягу ниток утоку на властивості ткано-в'язаного матеріалу

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Анотація. Актуальність дослідження зумовлена практичною потребою зменшити витрату піткальної (утокової) нитки за умови збереження структурної стабільності, розривних характеристик і товарознавчої якості матеріалу, що поєднує поздовжні ткані пруги з петельними з'єднаннями утоку. Метою статті було визначити вплив натягу ниток утоку на фізичні, механічні та структурні властивості ткано-в'язаного текстильного матеріалу артикулу 10с2, виробленого на лабораторній машині Метар-160. Для отримання експериментальних зразків використано поліефірні нитки основи лінійної густини 24,5 текс і поліефірні мультифіламентні нитки утоку лінійної густини 8,4 текс. Натяг утоку змінювали в межах від 9,2 до 14,8 сН на нитку шляхом зміни кількості та положення регулювальних вантажів на важелях регулятора утоку. У роботі оцінено розривне навантаження та розривне видовження за основою й утоком, розривні характеристики ниток утоку, вилучених з матеріалу, проєкційну довжину нитки утоку в площині матеріалу, фактичну витрату утоку на одне прокладання, ширину виробленого матеріалу, ширину окремого ткано-в'язаного пруга, товщину, стійкість до стирання, повітропроникність і стабільність фазової будови тканих ділянок. Установлено, що в дослідженому інтервалі підвищення натягу утоку не спричиняє критичного погіршення основних експлуатаційних показників. Проєкційна довжина утоку зменшилася з 13,38 до 13,11 мм на прокладання, фактична витрата утоку – з 15,28 до 14,81 мм на прокладання, коефіцієнт витрати утоку – з 1,142 до 1,130, тоді як ширина виробленого матеріалу зменшилася з 164,8 до 160,4 см. Отримані залежності обґрунтовують багатокритеріальний підхід, за якого натяг утоку застосовується як ресурсоощадний чинник лише в поєднанні з контролем розмірних характеристик матеріалу

Ключові слова: витрата утоку; петельне з'єднання; Метар-160; повітропроникність; стійкість до стирання; ресурсозбереження