Wpływ szwu na transport płynnej wilgoci w tkaninach

The influence of the seam on the transport of liquid moisture in woven fabrics

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Abstract

The human body is a lump, sewing and modeling clothes requires many stitches in places that produce sweat in a liquid form, these are: armpit, back, inner thighs. The finished seam consists of more than 2 layers of materials, and thus the property of the seam to manage moisture is difficult. Cotton woven fabric was tested and the seams on the left and right side of the woven fabric were compared. The test of liquid moisture transport was carried out on the SDL Atlas Moisture Management Tester. The samples were compared with each other.

Abstrakt

Ciało ludzkie jest bryłą, szycie i modelowanie ubrań wymaga wielu szwów w miejscach, w których wydziela się pot w postaci płynnej, są to: pachy, plecy, wewnętrzna strona ud. Gotowy szew składa się z więcej niż 2 warstw materiałów, a zatem właściwość szwu do zarządzania wilgocią nie jest łatwa. Badaniom poddano tkaninę bawełnianą, porównano ze sobą szwy, które zostały wykonane na lewej i prawej stronie tkaniny. Badanie transportu wilgoci w postaci cieczy przeprowadzono na aparacie SDL Atlas Moisture Management Tester. Próbki zostały ze sobą porównane.

Keywords: seam, transport of liquid, woven fabric, weave

Słowa kluczowe: szew, transport wilgoci, tkanina, splot

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1. Introduction

The seam is the basic fastener of the pieces of fabric. By sewing together pieces of fabric, we can create clothes, bedding, sails, uniforms, etc. The human body is a lump, sewing and modeling clothes requires many stitches in places that produce sweat in a liquid form, these are: armpit, back, inner thighs. The finished seam consists of more than 2 layers of materials, and thus the property of the seam to manage moisture is difficult. It is important that not only the textile material has the ability to wick away moisture, but also the seams should have similar properties, i.e. not retain moisture. Maanvizhi, Prakash, Rameshbabu [1] investigated the effect of seams on the comfort of use in sportswear, i.e. the ability to manage moisture, the breathability of the seam and whether its design does not irritate the user's skin.

Moisture transport in the form of liquid plays a very important role in shaping physiological comfort, which is a basic feature in the use of clothing. Ensuring the comfort of using clothing is currently one of the most important criteria in its production. From the point of view of physiological comfort, the ability to manage a moisture through clothing fabrics is very important [2]. The transport of moisture in liquid form through the fabric is shown in Fig. 1.

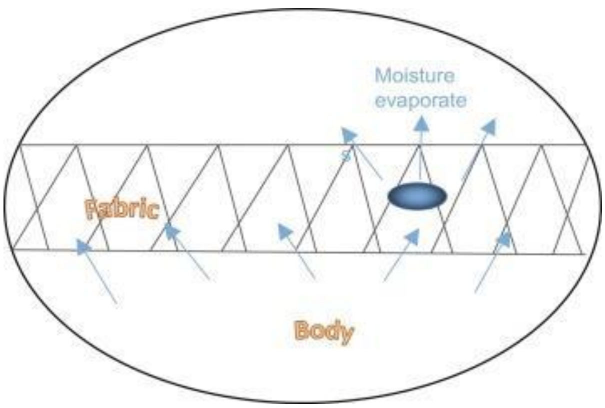

Fig. 1. Moisture management in clothing [3].

Woven fabrics are the most commonly used textile materials in the production of clothing. As woven fabrics are one of the most widely used textiles in the production of clothing. Moisture management has the following functions [4, 5]

- regulation of body temperature - sweat is produced when body temperature exceeds 37^{0}C. Suitable transport of moisture from the body surface to the environment reduces the body temperature;
- control of cloth weight increase;
- reducing skin damage.

2. Materials and methods

2.1. Materials

A pair of cotton woven fabrics with weaves: twill 3/1 S (right side of the woven fabric), twill 1/3 Z (left side of the woven fabric) sewn with stitches with a stitch pitch of 3 mm. Weave reports are presented in Fig. 2.

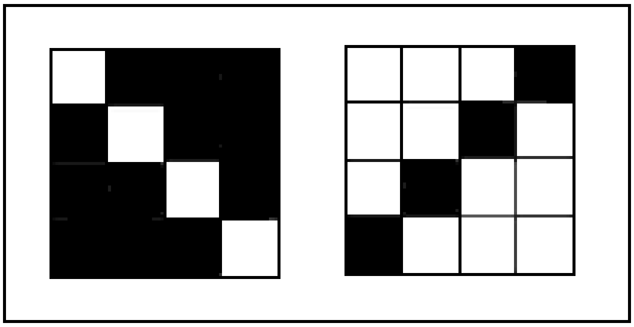

Fig. 2. Weave applied in the fabric variants manufactured, from left: twill 3/1 S, twill 1/3 Z.

All fabrics have been finished in the same way. The finishing process included: desizing, washing, rinsing and drying. The basic parameters of the tested fabrics are shown in Tab. 1.

Tab. 1. Basic structural properties of fabrics investigated.

Parameter	Unit	Value
Weave	-	3/1 S; 1/3 Z
Weft density	$threads \cdot dm^{-1}$	110
Warp	-	60 tex
Weft	-	100 tex
Warp density	cm^{-1}	32.0
Weft density	cm^{-1}	16.0
Mass per square metre	$g \cdot m^{-2}$	379
Warp crimp	*%*	11.8
Weft crimp	*%*	4.1
Thickness	*mm*	0.8
Stitch pitch	*mm*	3

The samples were folded in half and stitched and then folded. The test samples are shown in **Fig. 3.**

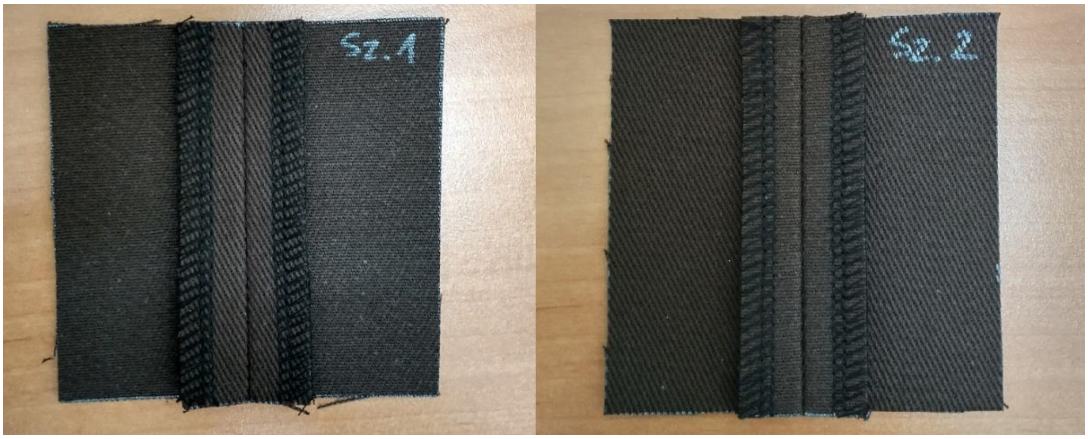

Fig. 3. Test samples, from left: seam 1 (twill 3/1 S), seam 2 (twill 1/3 Z).

2.2. Methods

Moisture transport through the seams was tested using the Moisture Management Tester (MMT) M290 from SDL Atlas according to the device manual based on the AATCC Method 195 -2011 [6]. This instrument is used to evaluate textiles in the transport of moisture in the form of liquid through these materials. The sample is placed horizontally in the instrument between the upper and lower sensors. A sweat-like solution is dropped to the centre of the upper surface (skin side) of the test sample. As the solution passes through the sample, changes in electrical resistance are measured and recorded.

Fig. 4. Moisture Management Tester M290.

The test solution (synthetic sweat) is carried through the material in three directions [7]:

- spreading on the upper surface of the fabric,
- moisture transfer through the fabric from the top to the bottom surface,
- spreading on the lower surface of the fabric.

The MMT provides the values of the following parameters were determined:

- WT T – wetting time of top surface, in s,
- WT B – wetting time of bottom surface, in s,
- TAR – absorption rate of top surface, %/s,
- BAR – absorption rate of bottom surface, %/s,
- MWR_{top} – maximum wetted radius for top surface, mm,
- MWR_{bottom} – maximum wetted radius for bottom surface, mm,
- TSS – spreading speed on top surface, mm/s,
- BSS – spreading speed on bottom surface, mm/s,
- R – accumulative one-way transport index, %,
- OMMC – Overall Moisture Management Capacity.

The MMT can identify 7 types of fabrics:

- waterproof fabric,
- water repellent fabric,
- slow absorbing and slow drying fabric,
- fast absorbing and slow drying fabric,
- fast absorbing and quick drying fabric,
- water penetration fabric,
- moisture management fabric.

The aim of the work was to test the seams for their ability to manage moisture. Five samples of each seamed fabric were prepared. The site of the drops was exactly above the seam.

3. Results

Results from the Moisture Management Tester are presented in Tab. 2 and 3, which present mean values from 5 measurements and the standard deviation of the results (in brackets).

Tab. 2. Results from Moisture Management Tester.

Sample	Weave	WT T *s*	WT B *s*	TAR *%/s*	BAR *%/s*	MWR_{top} *mm*
1	Twill 3/1 S	5.71 (0.56)	6.33 (0.63)	27.24 (3.02)	28.92 (2.70)	12 (2.74)
2	Twill 1/3 Z	6.40 (0.84)	7.79 (1.11)	34.36 (0.70)	31.11 (1.70)	10 (-)

Tab. 3. Results from Moisture Management Tester continue.

Sample	Weave	MWR_{bottom} *mm*	TSS *mm/s*	BSS *mm/s*	R *%*	OMMC -
1	Twill 3/1 S	11 (2.24)	1.57 (0.28)	1.44 (0.24)	36.38 (40.62)	0.19 (0.07)
2	Twill 1/3 Z	10 (-)	1.38 (0.13)	1.18 (0.14)	-8.22 (44.70)	0.12 (0.06)

On the basis of the obtained results, it was found that the tested samples differ in terms of the values of the indicators characterizing the moisture transport. The view of the samples after the test is shown in Fig. 5 – 6.

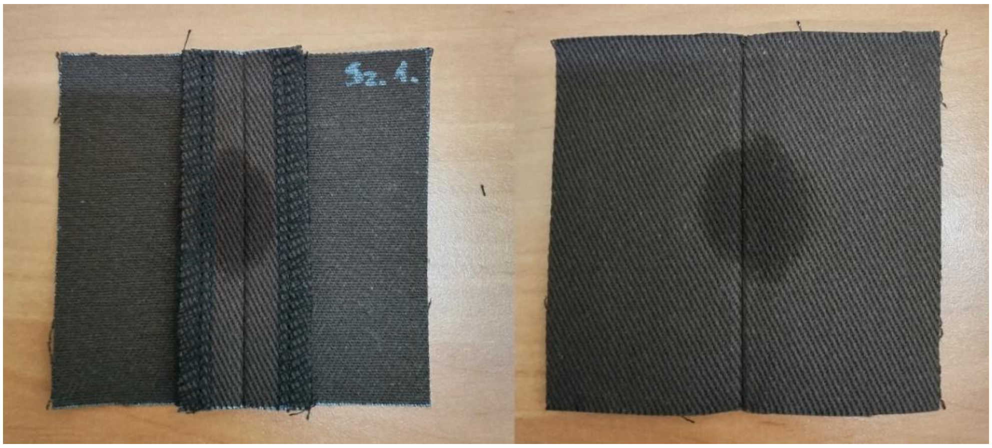

Fig. 5. Photo of the right and left side of sample 1 (twill 3/1 S) after test.

Fig. 6. Photo of the right and left side of sample 2 (twill 1/3 Z) after test.

Among all the parameters, it is easier to describe the values of the one – way transport index (R indicator) and OMMC indicator (Overall Moisture Management Capacity). The classification of fabrics according to the value of the accumulative one – way transport index is as follows [6]:

- < – 50 – very poor,
- – 50 – 100 – poor,
- 100 – 200 – good,

- 200 – 400 – very good,
- > 400 – excellent.

The R indicator characterizes the transport of liquid from the inside of the fabric to the outside. The one – way transport index (R indicator) is defined as variability of moisture accumulation between bottom and top layer of fabric [8]. Positive and high values of the R parameter show that sweat can be easily and quickly drained from the body surface. According to the above classification and the results presented in Tab. 3 it can be concluded that all samples according to the program classification achieved a poor result. Comparing samples 1 and 2, it can be noticed that the higher value of the R indicator was achieved by sample 1, i.e. the one in which the 3/1 S twill weave was the upper and lower side. In the case of 2 layers of fabrics, the moisture has to travel a longer distance. The OMMC indicator (Overall Moisture Management Capacity) is calculated by the software using 3 parameters:

- absorption rate of bottom surface,
- moisture spreading speed for the bottom surface of the sample,
- accumulated one – transport index.

The classification of fabrics according to the value of the Overall Moisture Management Capacity is as follow [6]:

- 0 – 0.2 – very poor,
- 0.2 – 0.4 – poor,
- 0.4 – 0.6 – good,
- 0.6 – 0.8 – very good,
- 0.8 – 1 – excellent.

Overall Moisture Management Capacity for all samples are classified as very poor from a moisture management point of view. Despite slight differences in the test results, it can be concluded that sample 1, in which the upper and lower layer was a 3/1 S twill weave, achieved a better result compared to sample 2. In the case of 2 layers of fabrics, the moisture has to travel a longer distance. Fig. 7 and 8 show the moisture content of the woven fabric after 2 minutes of measurement for samples 1 and 2.

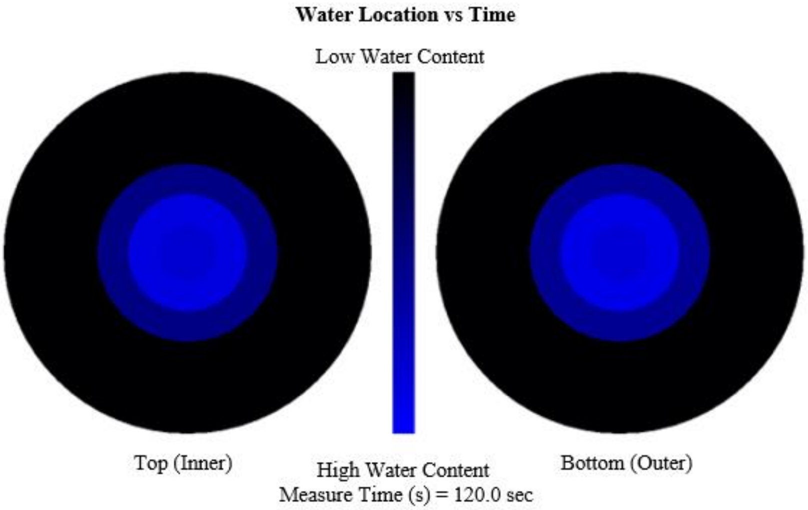

Fig. 7. Moisture content of the top and bottom surface for sample 1 after 2 minutes of measurement.

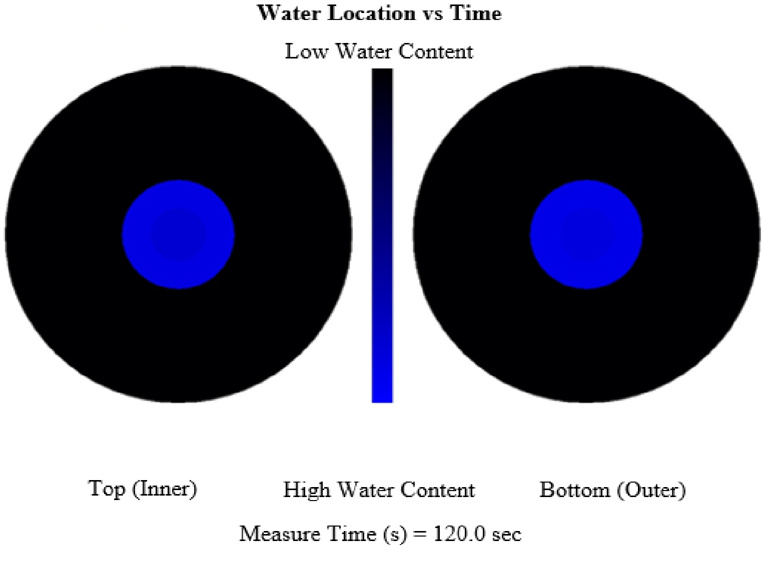

Fig. 8. Moisture content of the top and bottom surface for sample 2 after 2 minutes of measurement.

Comparing Fig. 7 and 8, it can be seen that in sample 2 the moisture is more concentrated than in sample 1. This applies to both surface.

4. Conclusions

- Both samples did not achieve satisfactory results. Due to the fact that cotton has hydrophilic properties and moisture had to penetrate through 2 layers of the fabric, the results are not satisfactory.
- The article "Effect of Stitch Density and Stitch Type on the Moisture Management Properties of Seams for High Active Sportswear Application" presents the results of research on moisture transport through seams in sportswear. Test results show that without seam modification, a reliable assessment of the moisture transport through these seams cannot be made.
- Despite of slight differences in the test results, it can be concluded that sample 1, in which the upper and lower layer was a 3/1 S twill weave, achieved a better result compared to sample 2 which the upper and lower layer was a 1/3 Z twill weave.
- To exhaust the topic of moisture transport through the seams, several types of seams and different types of thread should be used. In my research, I focused only on the most basic seam, which is found in most clothing materials.
- In order to find out what is the real effect of the weave on moisture transport, a number of different studies should be undertaken. First of all, take measurements in different places of the weave. This is a very interesting topic that requires more research.

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