THE INFLUENCE OF RAW MATERIAL ON THE LIQUID MOISTURE TRANSPORT THROUGH KNITTED FABRIC

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Abstract: *The comfort is undoubtedly the most important human attribute depends upon the moisture transport which in turn depends on the moisture transport behavior of the knitted fabric. Moisture transport is the transfer of liquid water capillary interstices of the yarns and depends on the wettability of fiber surfaces, as well as the structure of the yarn and fabric. Because of its good water absorption property, cotton is often used for next-to-skin wear such as t-shirts, underwear, socks.*
All these are known as ``moisture management`` which means the ability of a textile fabric to transport moisture away from the skin to the garment's outer surface in multi-dimensions and it is one of the key performance criteria in today's apparel industry since it has a significant effect on the human perception of moisture sensations.
In order to study, plated knitted fabric for socks were knitted as plated single jersey in the same production conditions, from different types of yarns, produced in different yarn counts (Ne 20, Ne 24, Ne 30) and different raw material. (cotton, bamboo, soybean, polyester, viscose). Were chose two different density on circular knitting machine.
The liquid moisture management of the samples was measured in order to determinate moisture transport index. Was study also the influence of raw material and fabric structure related to the moisture transport index. According to the obtained results, it was found that some of the knitted fabrics used in this study have good moisture management capability.

Key words: *comfort, moisture, plated single jersey, yarns*

1. INTRODUCTION

The moisture transfer is limited by the maximal quantity of humidity witch can be transfer from the body to the enviroment thru the clothing [1], [2], [3], [4], [5], [6], [7].

In order to ensure the wearing confort during a moderately sweat, the first textile layer (next to the skin), must maintain the microclimate as dry as possible. In the same time it should have a high capacity of the water vapours transfer, and a good humidity buffer. The buffer effect must match to the humidity flow and stay below to the absorption capacity [1], [2], [3], [4], [5], [7], [8], [9].

The most recomanded knitted fabrics, in the case of the person who in intesily sweting, are those with doble layers, one of them made by sintetic fibers and the second one made by natural fibers.

This knited fabrics, (figure 1.) offers a new value for the users as well as new functional characteristics, wich can not be found in the single layers knited fabrics, especially by those knitted by cotton yarns [2], [3], [4].

The double layer knitted fabrics made out of different fibres, the layer wich comes in the contact with the skin, (the back side), it is a hydrophobic layer also known as conductive layer and is made by syntethetic fibres [1], [2], [3], [4], [5], [6], [7].

The front part of the knitted fabric is the hidrophilic layer, made from natural or mixed fibres, with a high capacity of absorption and is called absorbant layer or sorption layer [2], [3], [4], [10], [12].

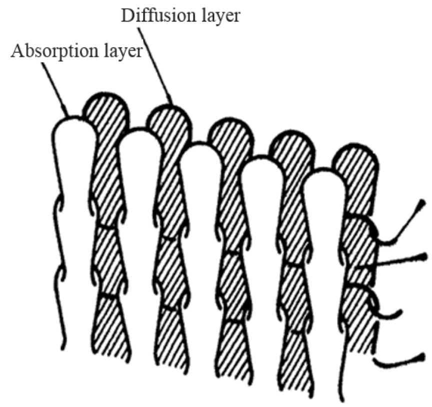


Fig. 1: *Double layer fabric structure [2], [3], [4]*

2. THE SAMPLES FOR TESTS

Were used different types of yarns (table 2) and codification of knitted fabric (table 1) according to the following parameters: knitted fabric geometry and density.

2.1. Knitted fabric geometry (figure 2):

The following patters were knitted: GV1 = plated single jersey, fabric density I (Do=50 wales/50mm, D_v=60 courses/50mm), GV2 = plated single jersey, fabric density II (Do=40 wales /50mm, Dv=50 courses /50mm) [11].

Were tested the samples plated jersey. In order to produce the fabrics 14 types of ground threads were used and plating thread was polyamide 6, 44/12x2 dtex. Samples were knitted in two variants of density: I and II (table 1).

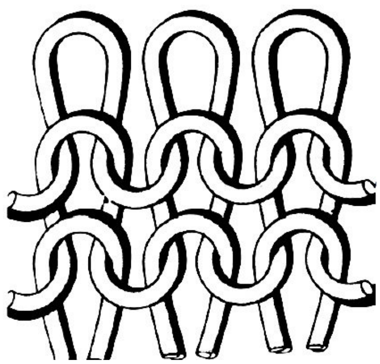


Fig. 2: *Knitted fabric geometry (plated single jersey)*

2.2. Knitted fabric density:

In the table 1 are displayed the density of samples knitted by ground yarn 1MDX cotton 34/1Nm (Table 2) and plating yarn Polyamide 6, 44/12x2 dtex.

Table 1: *Samples density*

Samples codification	Density code	Wale density and course density
GV1.1MDX	I	Do=50 wales/50mm, D_v=60 courses/50mm
GV2.1MDX	II	Do=40 wales /50mm, Dv=50 courses /50mm

Note: Do = horizontal density; Dv = vertical density.

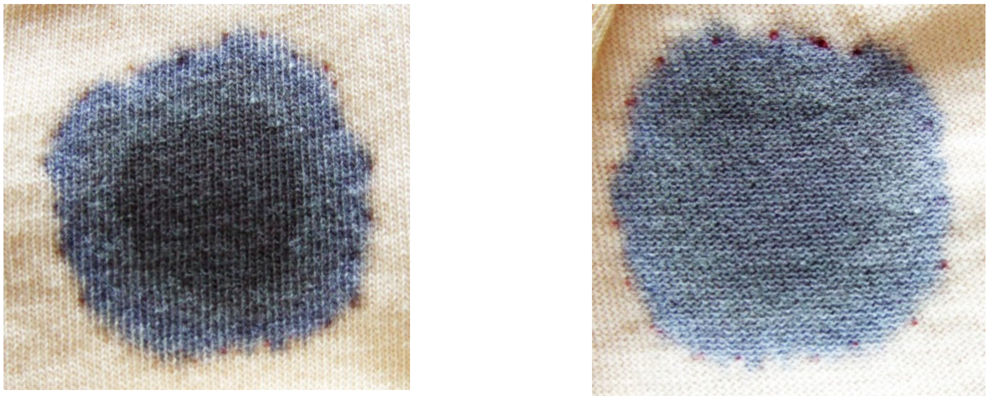
Table 2: *Raw material – fineness and codification [11]*

Code	Raw Material	Fineness	
		Ne	Nm
1MDX	Cotton 100%	20 / 1	34 / 1
2MDX	Cotton 100%	24 / 1	40 / 1
3MDX	Cotton 100%	30 / 1	50 / 1
1DC	Organic Cotton 100%	20 / 1	34 / 1
3DC	Cotton 100%	24 / 1	40 / 1
4DC	Cotton 100%	30 / 1	50 / 1
6DC	Cotton + soybean, (50% + 50%)	20 / 1	34 / 1
7DC	Polyester + Viscose, (52% + 48%)	20 / 1	34 / 1
8DC	Polyester + Viscose, (52% + 48%)(different supplier)	20 / 1	34 / 1
9DC	Tencel®	20 / 1	34 / 1
10DC	Bamboo + Viscose, (50% + 50%)	20 / 1	34 / 1
11DC	Viscose + Silk, (90% + 10%)	20 / 1	34 / 1
12DC	Polyester 100%, (Recycled)	20 / 1	34 / 1
13DC	Polyester 100%	24 / 1	40 / 1
2DC	Polyamid 6 (plated yarn)	44/12x2	40/12x 2

3. TESTS METHOD

The index of liquid moisture transport **i_u** [%] can be determined for the double layer textiles in order to demonstrate that this materials behave like an absorbent paper. 1 ml of water (mixed with dyer, wich does not interferes with the behavior of the material in humid enviroment) it is drop by drop from a distance of 10 cm on the conductive layer of the fabric [2], [3], [4].

According to patern characteristics of knitted fabric, the water drops are dispersed like different sizes spots on the sorption layer [2], [3], [4]. Photos will reveale the differences of the sizes of the spots on both layers (sorption layer (a) and conductive layer (b)) (figure 3) [2], [3], [4].



a) ***b)***

Fig.3: *The shape of the spot on the sorption layer (a) and the conductive layer (b) – plated fabric [11]*

The surfaces of the spots are marked with Sc for the conductive layer (b) and with Ss for the sorption layer (a) and then they are planimetred.

Using the values obtained after the planimetry we can calculate the index of the humidity transport, marked as i_u and calculate folowing equation 1 [2], [3], [4]:

$$i_u = \frac{S_c}{S_s} \cdot 100\ [\%] \quad \textbf{(1)}$$

Where:
Sc = surface of spot on conductive layer (cm^2),
Ss = surface of spot on sorption layer (cm^2).

4. TESTS RESULTS

The average values of the tests results obtained for 3 tests of each type of knitted fabrics are displayed in the folowing tables [11]:

Table 3: *The values of humidity transport index in case of plated single jersey, density I*

SAMPLES	Conductive layer (skin contact)		Sorption layer (face of the fabric)		Index of the humidity transport iu
	weight [g]	Surface Sc [cm²]	weight [g]	Surface Sc [cm²]	
GV1.1MDX	0.056	7.4	0.050	6.6	112
GV1.2MDX	0.050	6.6	0.046	6.1	109
GV1.3MDX	0.089	11.7	0.087	11.4	102
GV1.1DC	0.189	24.9	0.179	23.6	106
GV1.3DC	0.075	9.9	0.073	9.6	103
GV1.4DC	0.160	21.1	0.160	21.1	100
GV1.6DC	0.131	17.2	0.137	18.0	96
GV1.7DC	0.155	20.4	0.155	20.4	100
GV1.8DC	0.175	23.0	0.175	23.0	100
GV1.9DC	0.140	18.4	0.140	18.4	100
GV1.10DC	0.163	21.4	0.157	20.7	104
GV1.11DC	0.143	18.8	0.138	18.2	104
GV1.12DC	0.296	38.9	0.287	37.8	103
GV1.13DC	0.277	36.4	0.277	36.4	100

Table 4: *The values of humidity transport index in case of plated single jersey, density II*

SAMPLES	Conductive layer (skin contact)		Sorption layer (face of the fabric)		Index of the humidity transport iu
	weight [g]	Surface Sc [cm²]	weight [g]	Surface Sc [cm²]	
GV2.1MDX	0.059	7.8	0.059	7.8	100
GV2.2MDX	0.047	6.2	0.047	6.2	100
GV2.3MDX	0.091	12.0	0.091	12.0	100
GV2.1DC	0.165	21.7	0.157	20.7	105
GV2.3DC	0.059	7.8	0.059	7.8	100
GV2.4DC	0.112	14.7	0.109	14.3	103
GV2.6DC	0.126	16.6	0.119	15.7	106
GV2.7DC	0.163	21.4	0.154	20.3	106
GV2.8DC	0.181	23.8	0.166	21.8	109
GV2.9DC	0.123	16.2	0.115	15.1	107
GV2.10DC	0.108	14.2	0.114	15.0	95
GV2.11DC	0.145	19.1	0.148	19.5	98
GV2.12DC	0.312	41.1	0.312	41.1	100
GV2.13DC	0.203	26.7	0.217	28.6	94

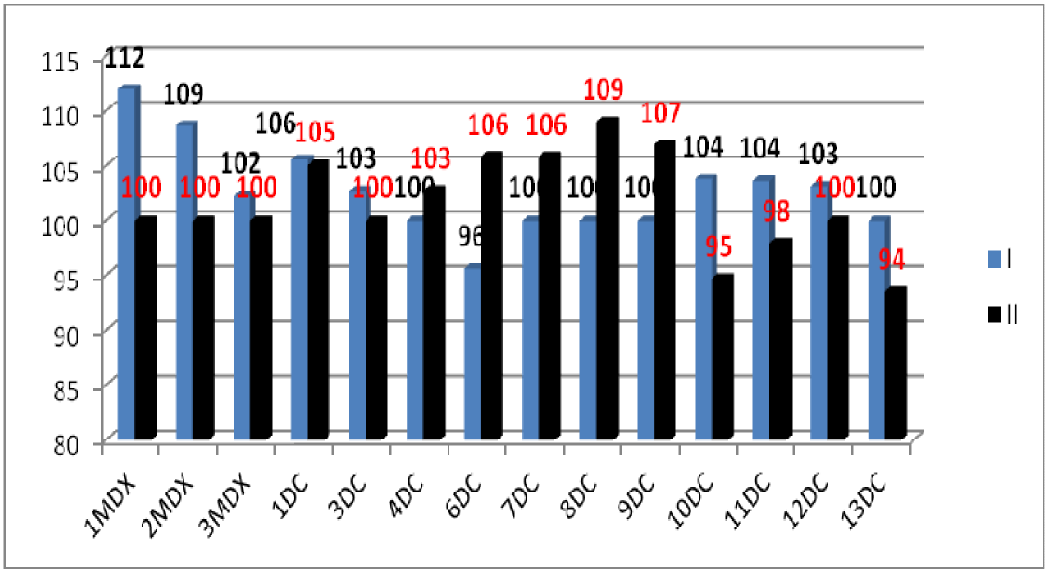


Fig.4: *The influence of the fabric density and the thread type on the humidity transport index for the plated jersey samples [11]*

5. CONCLUSIONS

The GV1.1MDX type of kitted fabrics, has the best humidity (liquid status) transport index for density I, and the GV1.8DC type for density II. (table 3, figure4).

For the knitted fabrics GV1.1MDX, GV1.2MDX, GV1.3MDX made from cotton 100% + polyamide 44/12x2 dtex, the humidity transport index increases with 6,86% when the ground yarn 50/1 Nm is replaced by yarn 40/1 Nm. In case of using ground yarn 34/1 Nm the humidity transport index increases with 2,75% comparing with knitted fabrics made from ground yarn 40/1 Nm.(table 3., figures 4)

For the GV1.7DC și GV 1.10DC types of fabric made by mixture of fibers, the percentage of 52 % polyester decreases the humidity transport index by 4%. (table 3, figure 4).

Comparing the GV1.12DC and GV1.13DC fabrics made from polyester yarns, the humidity transport index is higher with cu 3%, for the GV1.12DC type.

Comparing the GV1.1MDX și GV1.6DC knitted fabrics, the percentage of 50% soya, decreases the humidity transport index with 16,66 %. (table 3., figure 4)

The GV1.1MDX type knitted fabric (regular cotton) has a humidity transport index 6,66% higher than the GV1.1DC type one (organic cotton). (table 3., figures 4).

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