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AN ANALYSIS OF THE INFLUENCE OF THE TEXTILE MATERIAL DOUBLING PROCESS BY THERMOFUSING ON VAPOR PERMEABILITY

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Abstract: *To confer shape and volume parameters, to ensure dimensional stability of surfaces and contours, some parts of clothing are doubled using the process of thermofusion with certain woven or nonwoven chemicalized materials. A priority in the work of producers of fabrics and textiles is to ensure comfort parameters and functions of apparel products are met and respected. Clothing products should ensure optimum insulation, air permeability, moisture absorption and transfer in order to give the wearer wellbeing and safety. In this paper we propose to analyze the influence of the technological process of doubling on the vapour permeability of the doubled assembly, compared with the permeability of the non-doubled material. As materials made of natural fibers are increasingly required, we focused on two natural fiber fabrics – 100% linen and 100% cotton - and a mixed natural fiber material – 64% linen, 34% viscose and 2% elastane. They were each doubled using thermofusion with woven or nonwoven chemicalized materials composed of wool mixed with polyamide. Laboratory measurements allow us to conclude to what extent the vapor permeability of the thermofused assemblies is influenced.*

Key words: *vapour permebility, hygroscopicity, clothing comfort parameters, chemicalized woven materials, chemicalized nonwoven materials, thermofusing.*

1. INTRODUCTION

Analysis of the influence of thermofusing processes on the parameters of comfort lead to the choice of suitable doubling materials that keep these parameters in optimal limits. Manufacturers of textiles and clothing are permanently preoccupied with creating clothing assemblies, especially multilayered assemblies, that do not severly adversely affect the characteristics of the base materials [1, 2, 3].

2. GENERAL INFORMATION

Vapour permeability is a material's property to let water vapour pass from an environment with high relative humidity, to an environment low relative humidity. Due to this property humidity from the body surface can be removed through materials or clothing [4, 5, 6].

3. MATERIALS AND METHODS

The water vapour permeability of a fabric can be measured in laboratory conditions, by noting the difference in mass due to the amount of vapour absorbed by a hygroscopic substance or layer from the conditioning atmosphere, in direct contact or through the textile material to be analyzed [4].

3.1. Materials

We used circular samples of:

- 100% linen (**1**), 100% linen doubled using thermofusion with woven chemicalized materials composed of wool mixed with polyamide (**1'**), 100% linen doubled using thermofusion with nonwoven chemicalized materials composed of wool mixed with polyamide (**1"**);
- 100% cotton(**2**), 100% cotton doubled using thermofusion with woven chemicalized materials composed of wool mixed with polyamide (**2'**), 100% cotton doubled using thermofusion with nonwoven chemicalized materials composed of wool mixed with polyamide (**2"**);
- mixed natural fiber material – 64% linen, 34% viscose and 2% elastane (**3**), mixed natural fiber material – 64% linen, 34% viscose and 2% elastane, doubled using thermofusion with woven chemicalized materials composed of wool mixed with polyamide (**3'**), mixed natural fiber material – 64% linen, 34% viscose and 2% elastane, doubled using thermofusion with nonwoven chemicalized materials composed of wool mixed with polyamide (**3"**).

3.2. Methods

Of each type of doubled material or assembly, four circular samples were taken, which cover the Herfeld glasses. The results obtained represent the arithmetic mean of the determinations for each type of sample. Materials doubled or not, are fixed to the mouth of each Herfeld glass, which contains 50 cm^3 of distilled water. The glass is introduced into the exicator environment, i.e. with 0% relative humidity, created using calcium chloride. The initial weight of the glass, water and material (M_1) assembly is measured and then at different time points after exposure to the low humidity environment (M_v). The difference in mass allows the calculation of the vaporisation index or of the vapor passage resistance of a material or a doubled textile assembly[4].

Vapor permeability is calculated using the formula [4]:

$$P_v = M_1 - M_v \ \ [g] \qquad \textbf{(1)}$$

Vaporization coefficient (μ) is calculated using the formula [4]:

$$\mu = P_v / S \times T \ \ [g/m^2\, h] \qquad \textbf{(2)}$$

Where: S – vaporization surface [m^2]
T – vaporization time [hours]

4. RESULTS

Table 1: *Vapour permeability and vaporization coefficient for the three matherials in there three variounts.*

No.	Material type	Initial mass M_0(g)	Mass variation in different time intervals $\Delta M = M_0 - M_i$ (g)								μ (g/m^2 h)	PV (g)
			1h	2h	3h	4h	5h	24h	48h	72h		
			M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8		
0.	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*	*12.*
1.	**1**	109,54	109,47	109,42	109,36	109,30	109,25	108,75	107,95	107,58	10,26	0,58
2.	**1'**	102,03	101,89	101,84	101,78	101,74	101,70	101,33	100,80	100,34	7,220	0,49
3.	**1"**	121,66	121,48	121,42	121,32	121,30	121,25	120,87	120,32	119,87	7,370	0,50
4.	**2**	100,69	100,61	100,56	100,49	100,41	100,35	99,78	98,78	98,27	11,13	0,75
5.	**2'**	111,41	111,27	111,24	111,20	111,16	111,10	110,90	110,42	110,02	7,850	0,37
6.	**2"**	112,48	112,38	112,37	112,32	112,28	112,23	111,95	111,56	111,21	8,600	0,49
7.	**3**	101,62	101,56	101,49	101,43	101,37	101,32	100,53	99,56	98,69	19,53	0,92
8.	**3'**	112,96	112,93	112,89	112,81	112,75	112,69	112,15	111,44	110,72	12,47	0,71
9.	**3"**	111,14	111,09	111,05	110,97	110,91	110,85	110,24	109,47	108,78	13,12	0,73

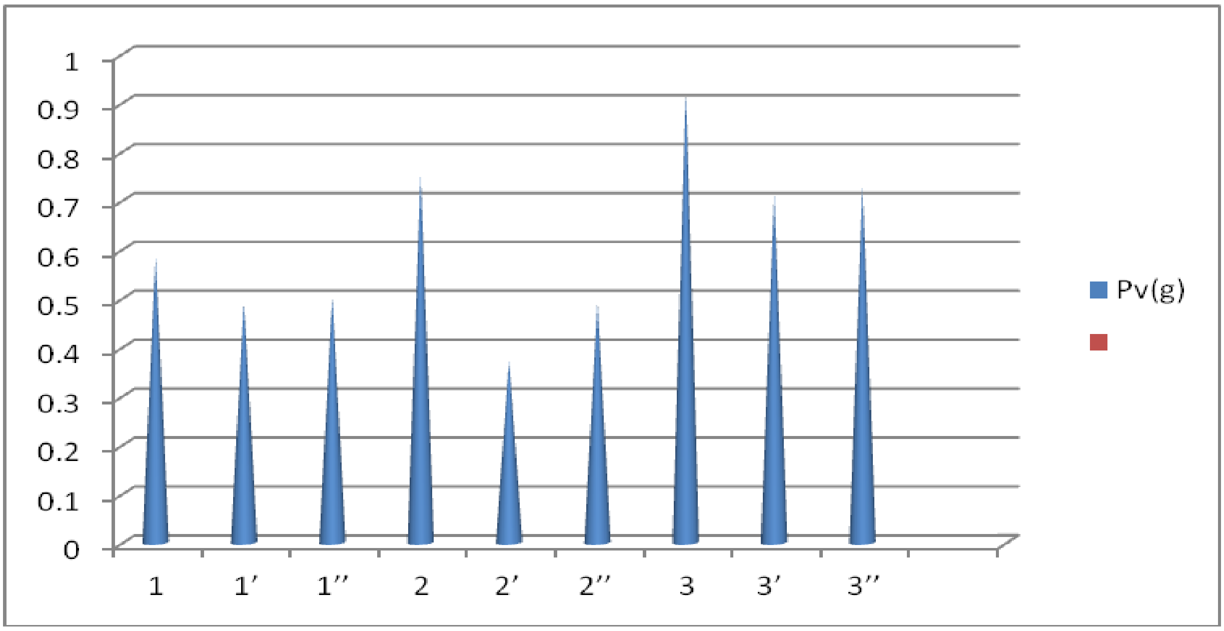

Fig. 1: *Vapour permeability for the three matherials in there three variounts.*

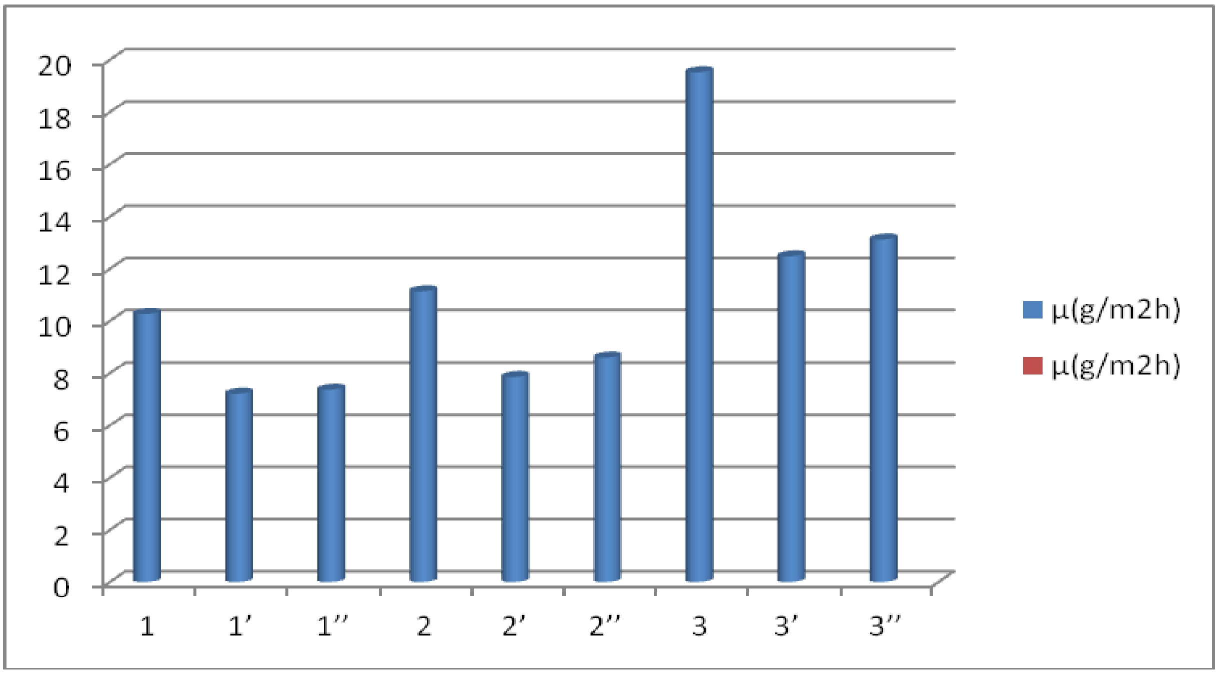

Fig. 2*: Vaporization coefficient for the three matherials in there three variounts.*

It is noted that the vapor permeabilities (Pv) in all three materials, unfused or fused with chemicalized woven or non-woven materials, have decreased values, starting with unfused materials, then thermofused with chimicalized unwoven materials and finally thermofused with chimicalized woven materials. The thickness of the material and the structure of the assembly of layers influences the vapor permeability. Also the resulting of vaporization coefficient (µ) demonstrates a significant influence of doubling process by thermofusing, on vapour permeabiliality for the three types of materials, unfused or fused with woven or nonwoven chemicalized materials.

Also is demonstrate the viscose influence on vapor permeabilities (Pv) and vaporization coefficient (µ) of material 3, 3'şi 3'',because the high level of them higroscopicity.

5. CONCLUSIONS

Producers of textile clothing should note that for products intended for the cold season it is optimal that parts of clothing are thermofused with chemicalized woven materials, which have a lower coefficient of vaporization. We specify that for the cold season, it is indicated that parts of the products are backed with chemicalize woven materials, thanks to a low coefficient of vaporization, knowing that for this season, the important parameter is insulation, while air permeability and absorption of moisture parameters are less important. For intermediate seasons, such as spring and autumn, it is advisable to use a nonwoven chemicalized material which provides average permeability values with respect to those indicated for the winter, and summer respectively.

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