# AIR PERMEABILITY OF CHEMICALLY FINISHED FABRICS

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**REZUMAT. Procesele de vopsire şi finisare a textilelor, influenţează permeabilitatea aerului şi, implicit, celelalte caracteristici de confort termofiziologic (permeabilitatea la vapori, izolaţia termică), determinând domeniul folosirii unei ţesături textile. Lucrarea prezintă rezultatele cercetărilor realizate pe probe de ţesături cu structuri diferite, confecţionate din fire de poliester în sistemul de urzeală şi bătătură, cu densităţi de lungime diferite. Pentru fiecare variantă de ţesături, sunt analizate proprietăţile ţesăturilor brute, ţesăturile vopsite şi ţesăturile acoperite cu strat dublu acrilat (straturi de protecţie împotriva vântului). Scopul cercetării este de a sublinia influenţa proceselor de finisare chimică (vopsire şi acoperire) asupra valorilor permeabilităţii aerului. Valorile experimentale obţinute pentru permeabilitatea aerului şi coeficientul de permeabilitate în aer au permis determinarea domeniului de utilizare al ţesăturilor analizate.**

**Cuvinte cheie:** tesaturi, fire, permeabilitate la aer, coeficientul permeabilitatii la aer, procese de finisare

**ABSTRACT. Textile dyeing and coating finishing processes, influence the air permeability and, implicitly the other thermo physiological comfort features (vapour permeability, thermal insulation), causing the domain using of a textile fabric.The paper presents the results of the researches realized on samples of fabrics with different structures, made from polyester yarns in the warp and weft system, with different length densities. For each variant of fabrics, the properties of the raw fabrics, the dyed fabrics and the coated fabrics with double acrylate layer ( wind protection layers) are analyzed. The purpose of the research is to emphasize the influence of chemical finishing processes (dyeing and coating) on air permeability values. The experimental values obtained for air permeability and the air permeability coefficient, have allowed the determination of the domain of use of the analysed fabrics.**

**Keywords:** fabrics, yarns, polyester, air permeability, air permeability coefficient, finishing processes

## 1. INTRODUCTION

The paper presents research results for the air permeability, for fabrics made of rotoset polyester yarns, in different stages of chemical finishing (raw fabrics, dyeing fabrics, coating fabrics) [1, 2]. The present research analysed three variants fabrics with rotoset polyester yarns, with different warp and weft length densities (table 1). The fabrics have undergone chemical finishing as painting and filing the protective films on fabric [3, 4]. It was analysed the air permeability. The values obtained for the fabric relating to air permeability of fabrics and air permeability coefficient can be used in practical for determining the areas of use of fabrics and the destination [5, 3].

*Table 1.* **Experimental variants of fabrics**

| **Fabrics variants $V_i$** | | **Yarn characteristics** | | **Density [yarns/10cm]** | |
|---|---|---|---|---|---|
| | | **Warp Rotoset polyester yarns** | **Weft Rotoset polyester yarns** | **Warp [yarns/10cm]** | **Weft [yarns/10cm]** |
| $V_1$ | $V_{11}$ | Tden=150den | Rotoset polyester yarns,Tden=300den | 380 | 190 |
| | $V_{12}$ | | | | |
| | $V_{13}$ | | | | |
| $V_2$ | $V_{21}$ | Tden=75 den | Rotoset polyester yarns, Tden=75 den | 380 | 300 |
| | $V_{22}$ | | | | |
| | $V_{23}$ | | | | |
| $V_3$ | $V_{31}$ | Tden=150x2den | Rotoset polyester yarns, Tden=300 den | 190 | 190 |
| | $V_{32}$ | | | | |
| | $V_{33}$ | | | | |

* i - fabric option; j – finishing variant chemical fabric

## 2.EXPERIMENTAL METHOD

The research studied fabrics made of rotoset polyester yarns with different densities of length. STAS 9005/71 [5, 6]. The pressure difference with which the determinations were made was 2, 4, 6 mm.water column.

## 3.RESULTS AND DISCUSSION

The experimental values of air permeability $P_a$ [$m^3$/min x $m^2$] and air permeability coefficient i [Kg/$m^2$h] [5] are presented in tables 2.

The air permeability coefficient is a direct indicator for air permeability, related with environment condition (temperature) [5,6].

The air permeability coefficient i [Kg/$m^2$h] is calculated for 20°C air temperature.

The fabric variants tested for air permeability at 2mm. water column, pressure difference.

Table 2 shows that the air permeability values of dyed fabrics, regardless of the fabric version, are slower in comparison with the raw fabrics.

This is due to the fact that in the process of dyeing fabrics a number of fabric shrinkage phenomena can occur, which leads to changes in the porosity of the fabrics.

The coating of fabrics with double acrylic layer has the effect, the air permeability of the variants of

In the figure.1 are presented the values of air permeability for raw fabrics variants and dyed, using the values from table 2.

*Table 2.* **The experimental values of air permeability $P_a$ [$m^3$/min x $m^2$] and air permeability coefficient i [Kg/$m^2$h]**

| The cod of fabrics $V_{ij}$* | $P_a$ [$m^3$/min x $m^2$] | i[Kg/$m^2$ h] |
|---|---|---|
| $V_{11}$ | 2.054 | 149.120 |
| $V_{12}$ | 1.188 | 86.2488 |
| $V_{13}$ | air impermeable | air impermeable |
| $V_{21}$ | 8.453 | 613.687 |
| $V_{22}$ | 4.660 | 338.316 |
| $V_{23}$ | air impermeable | air impermeable |
| $V_{31}$ | 2.675 | 194.205 |
| $V_{32}$ | 2.258 | 163.9308 |
| $V_{33}$ | air impermeable | air impermeable |

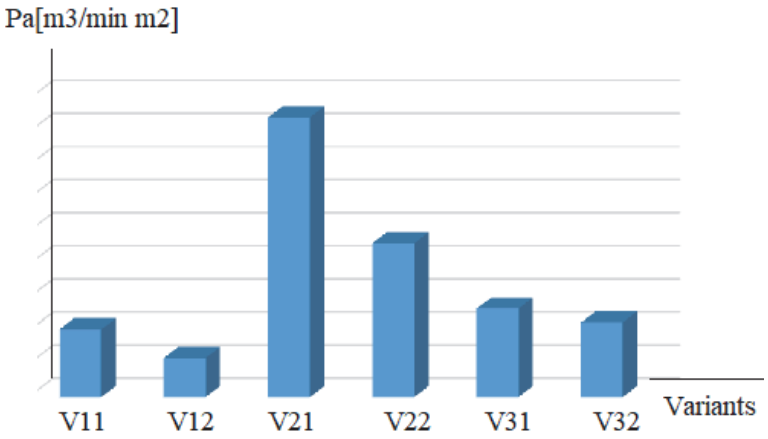


**Fig. 1** Histogram of air permeability values

From figure 1 can be observed that the air permeability of dyed fabrics variants ($V_{12}$, $V_{22}$, $V_{32}$) is slower than raw fabrics.

Through coating, the fabrics became air impermeable.

The air permeability of the dyed fabrics is less by 22.05% compared to the air permeability of the raw fabrics.

The $V_2$ variant has the highest air permeability. The air permeability of the raw fabrics of $V_2$ variant is with 68.37% higher than the fabrics of $V_3$ and 75.71% respectively to $V_1$ fabrics.

In the case of dyed fabrics, the air permeability of $V_2$ fabrics is higher by 51.55% compared to V3 fabrics and by 74.51% compared to fabrics of V1 variant.

In order to analyze the influence of the air pressure value on the air permeability, the fabrics were also tested with values of 4mm.water column respectively 6mm.water column (table 3). Table 3

*Table 3.***The values of air permeability at different pressure values**

| The cod of fabrics$V_{ij}$* | $P_a$ [$m^3$/min x $m^2$] 4mm.water column | $P_a$ [$m^3$/min x $m^2$] 6mm.water column |
|---|---|---|
| $V_{11}$ | 3.735 | 5.5 |
| $V_{12}$ | 2.371 | 3.514 |
| $V_{13}$ | impermeable | Impermeable |
| $V_{21}$ | 16.043 | 19.863 |
| $V_{22}$ | 9.508 | 14.431 |
| $V_{23}$ | impermeable | impermeable |
| $V_{31}$ | 4.456 | 6.451 |
| $V_{32}$ | 3.098 | 4.058 |
| $V_{33}$ | impermeable | impermeable |

The warp and weft density of fabrics and the length density of yarns determine the differences in air permeability in the fabrics analysed.

The fabrics of the $V_2$ variant, although it has 380 [yarns/10cm] warp and weft density, and the length density of yarns is lower, the air circulation through the pores of the fabric is superior to the other fabrics.

## 4.CONCLUSIONS

The research has been targeted on three fabrics with different structures ($V_1$, $V_2$, $V_3$) (table 1, table 2) on three textile finishing ranges (raw fabrics $V_{i1,}$ dyed fabrics $V_{i2}$ and coated fabrics with two acrylic layers $V_{i3}$).

Take into consideration the results; it can conclude that the coated fabrics analyzed in this paper can be used for air impermeable clothing.

The air permeability of the fabrics is influenced by the structure, the structural characteristics of the fabrics and the process of finishing the fabrics.

Theoretically, between the value of air permeability and the pressure difference, there is a directly proportional relationship. But in the case of chemical finishing treatments, with acrylic double layer, a decrease in air permeability is observed, following the finishing treatments.

The air permeability of the fabrics has higher values for the raw fabrics and decreases in the case of the dyed fabrics, while the air permeability of the fabrics coated with double acrilic laye has minimum values (impermeable).

Textile dyeing and coating finishing processes, influence the air permeability and implicitly, the other thermophysiological comfort features (vapour permeability, thermal insulation), causing the using of a textile fabric.

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