INVESTIGATION ON INFLUENCE OF ANTIMICROBIAL TREATMENT ON STRUCTURAL AND PHYSICAL PROPERTIES OF TEXTILE

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EXTENDED ABSTRACT

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1. INTRODUCTION

Antimicrobial fabrics are important not only for medical application, but also in terms of daily life usage (everyday, sports and leisure wear, socks and underwear, etc.). The application of antimicrobial finishes to textiles can prevent bacterial growth on textiles. Chemical or mechanical operation for the treatment of the product to improve its features and appearance is called product finishing. It will change fabric's or products physical and / or aesthetic properties, like texture or surface characteristics [1]. Chemical or antimicrobial finish has various importance due to its relation with healthcare and medical textiles. Antimicrobial agents inhibit the growth or kills microbes to control their negative effect e.g. odour, staining and deterioration. Microbes are the tiniest of creatures, which cannot be seen by the naked eye [2]. They consist of a variety of micro-organisms e.g. bacteria, fungi, algae and viruses etc. [3]. The antimicrobial agents are foreseen on the basis of natural, synthetic, chemistry, the mechanism of antimicrobial activity, efficiency and washing resistance. Antimicrobial agents are usually applied at the finishing stages of textile production, while in some cases biocide can be incorporated into synthetic fibres during extrusion. Natural antimicrobial agents can be applied to textile by different methods such as pad-dry-cure, coating, spray and foam techniques. It can also be applied directly by adding the antimicrobial agent into the spinning fibre solutions. Some of the well-acclaimed methods for application of natural products for impacting antimicrobial finishing to fabrics are as folows: direct application techniques; nanotechnology; insolubilisation of the active substances in/on the fibre; treating the fibre with resin, condensates or cross-linking agents; microencapsulation of antimicrobial agents with the fibre matrix and fibre surface modification [4].

The aim of the present work was to establish the influence of non-toxic antimicrobial textile finishing on antimicrobial activity as well as on changes of structural parameters and physical properties, such as air permeability.

2. MATERIALS AND METHODS

Experimental samples were knitted in a rib 1×1 pattern on a flat 10E gauge double needle-bed weft knitting machine CMS530 (Stoll, Germany). The samples were knitted using yarns of different raw material: acrylic yarns, with linear density 31 tex ×2; woollen yarns, with linear density 35 tex ×2; wool / acrylic blended yarns, with linear density 34 tex ×2.

All experiments were carried out in a standard atmosphere according to Standard ISO 139. Structure parameters of the knitted samples were analysed according to British Standard BS 5441:1998.

Benzalkonium chloride was used as antimicrobial agent, which agent was covered on the textile materials using the method of wet impregnation. The main conditions of antimicrobial treatment were as follows: aqueous solution of 30°C, 30 ml/l of particle bactericidal and 6 ml/l of auxiliary bactericidal, treatment duration 15 min. After that drying for 15 min at 120 °C was applied. The antimicrobial efficiency of samples was tested with the Gram negative bacteria *E. coli* (KMY1T) and the Gram-positive bacteria *S. aureus* (ATCC25923). The evaluation of antimicrobial efficiency was carried out in accordance with EN ISO 20645:2004 (Agar diffusion plate test). The samples were washed five times, after each washing and drying cycle measuring their antimicrobial activity.

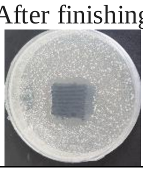
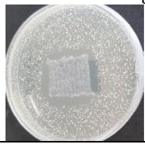
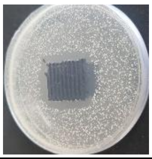
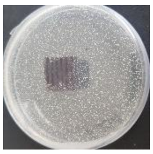
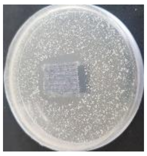
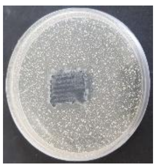
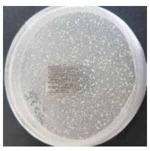
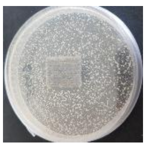
Air permeability tests of the knitted fabrics were conducted according to Standard EN ISO 9237:1997 using a head area of 10 cm^2 and pressure difference of 200 Pa.

Washing was performed for (10±0.5) min in (40±2) °C temperature and 3 g/l washing powder concentration washing solution, the samples where three times rinsed in (20±2) °C temperature. Duration of each rinse was (5±0.1) min. The rinsed samples were spun (frequency of revolution 1000 min^{-1}) for (1±0.1) min and 24 h dried on a smooth surface.

3. EXPERIMENTAL RESULTS AND DISCUSSION

Woollen and wool/acrylic blended knitted fabrics showed better antimicrobial activity and its durability after washing than the acrylic one. Acrylic knitted sample did not exhibit antimicrobial resistance to washing (see in Table 1). These results are influenced by the raw material of the knitted samples.

Table 1. Antimicrobial activity of tested knitted fabrics

Woollen	**Acrylic**	**50/50% woollen/acrylic**
After finishing 	After finishing 	After finishing 
After the first wash 	After the first wash 	After the first wash 
After the fifth wash 	After the fifth wash 	After the fifth wash 

Results of the air permeability test show that the highest air permeability has the acrylic knitted fabric, and the lowest – fabric knitted from wool/acrylic blended yarns (see in Fig. 1). These results were influenced by the thickness of the yarns and the loop density of the knits, as porosity of knitted fabric is the main parameter which determines permeability to air.

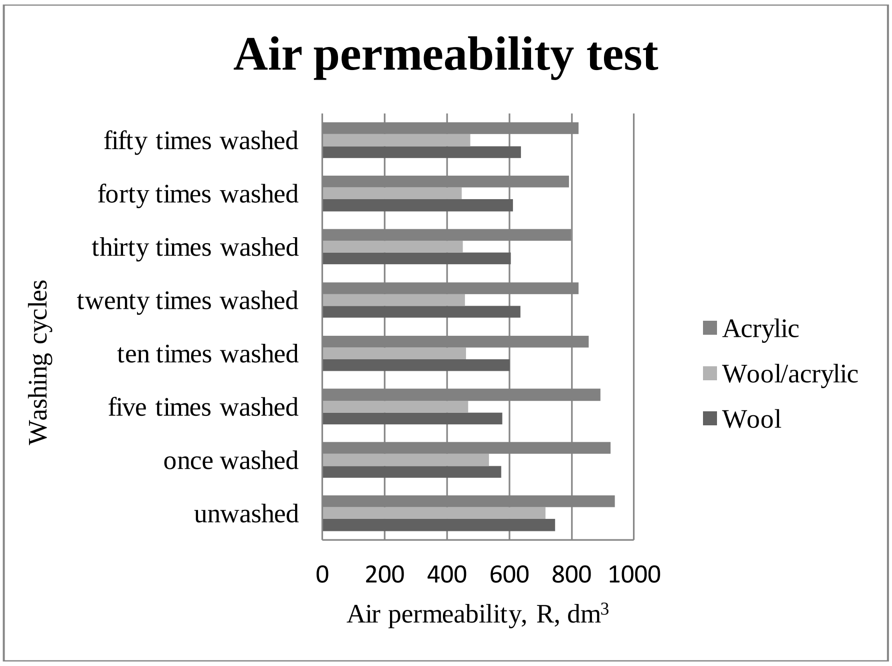


Figure 1. Air permeability of tested knitted fabrics

The highest drop in the air permeability was observed up to 5 washing and drying cycles, especially for woollen and blended knitted fabrics. This is because of woollen structures tendency to shrink and tighten during the wet treatment (in our case washing). After some number of washing cycles (~5 for woollen and blended and ~10 for acrylic structures) air permeability stops to change after additional wet treatment, however, after 50 washing cycles it starts to increase, and it is because of significant loss of fibres from the knitted structure.

4. REFERENCES

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