

Influence of different finishing treatments over mechanical and thermal properties of bed linen

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ABSTRACT

This work aims to assess the relationship between the mechanical and the thermal properties of summer bed linen using different softener formulations in home textiles finishing. Objectively, we intend to study the effect of different softeners and their concentrations, based on non-ionic polyethylene dispersions and a cationic silicone softener micro-emulsion on textile properties.

The research shown that thermal related properties are influenced by polyethylene softeners, while the silicone softener influences the mechanical behavior of the tested samples. Finally, selected softened samples of bed linen were evaluated by a dry thermal manikin to validate some conclusions.

INTRODUCTION

Softening is a required process stage in the finishing of textile products. It is usually the final step of the process of finishing and results from the application of compounds which internally lubricate the fibers and make the tissue more smooth, soft and flexible.

The chemical nature of softeners can either be cationic, anionic or non-ionic, usually supplied in liquid dispersions. Their application has the purpose to facilitate the process and to improve the fabrics [1].

Most studies on the effect of softeners on textile properties have been focused on the appearance and maintenance properties of materials. Thus, whiteness, pilling formation, wrinkle recovery and dimensional stability were usually considered. However, despite the importance of the comfort properties during the purchasing choice by consumers, studies on the influence of softeners on the thermal comfort are rare [2].

Also, studies concerning thermal measurements of home textiles with the use of the thermal manikins are inexistent.

Thermal comfort is related to the sensations of heat or cold, moisture or dryness and influence the performance of textile products used near the skin, such as bed linens. Additionally, the mechanical properties are very important, because of the daily use and combined strain.

MATERIALS AND METHODS

The fabric samples are from 100 % light cotton satin, preferable used for summer linen, weighing 145 g/m², before finishing.

Six, commercial fabric softeners (A,B,C,D,E and F) were added in 5 different concentrations (5, 10, 20, 40 e 150 gL⁻¹) to the finishing bath composed by a resin, a catalyst and a surfactant auxiliary product. After impregnation using a pick up of 60%, the fabrics were dry at 120 °C during 1.5 minutes and fixed at 180°C during 30 seconds. A sample without any softener (control sample) was also studied.

The tested mechanical and thermal properties are present in table I.

TABLE I. Description of the tested properties made according specific standard tests

Mechanical properties	Thermal properties
Tear resistance	Heat flux
Abrasion resistance	Thermal resistance
Seam slippage	Thermal conductivity

The obtained results were treated statistically and the reproducibility of the different results, for each variable, was tested and analyzed.

RESULTS AND DISCUSSION

The mechanical properties were improved by silicone softeners, which is in agreement with that described in the existing literature [3]. However, the polyethylene softeners have a different behavior, depending on the formulation and concentration in use. In some cases very high concentrations are needed to influence the studied mechanical properties.

In order to assess the tested thermal properties, heat flux, thermal resistance and thermal conductivity properties were evaluated in the different finished samples. It was noted that the application of certain polyethylene softeners improves the thermal behavior, namely the heat flux and thermal conductivity.

The best relationship between the mechanical and thermal behavior was obtained with the application of 40gL⁻¹ of softener C and 150gL⁻¹ of softener E, both polyethylene based fabric softeners.

Therefore, thermal insulation of these formulations was evaluated through thermal manikin measurements. The goal was to maintain the skin temperature at 33 °C. (Figure 1).



FIGURE 1. Thermal manikin measurements with the selected finished bed linens C and E

The next figure 2 shown the heat flow comparing the formulation C and E with the measurement of the nude manikin.

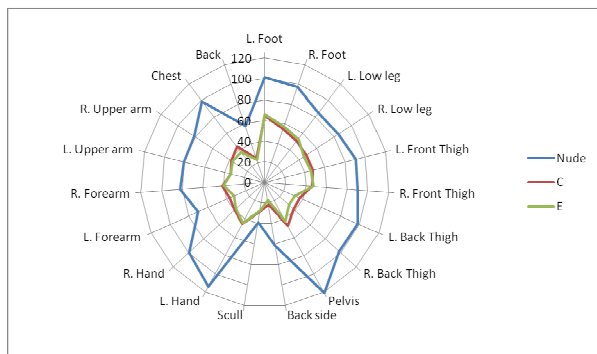


FIGURE 2. The heat flux (W/m^2) to maintain the skin temperature constant at 33 °C

We can observe that the finished bed linen isolates substantially the body, regardless of the formulation applied.

Nevertheless, no significant differences were observed with the use of the two different polyethylene formulations of softeners, in terms of thermal comfort (Figure 3).

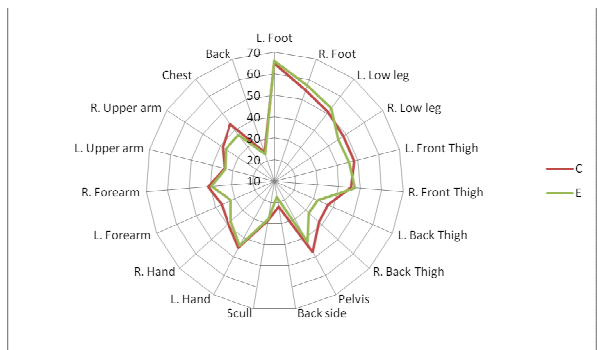


FIGURE 3. Enlargement of the heat flux (W/m^2) to maintain the skin temperature constant at 33 °C

The slight decrease of heat flux (more isolation) observed in the measurements with the softener E ($150gL^{-1}$), can be justified by the deposition of softener residues on tissue surface, which may create a barrier to airflow and wicking of the fabric, as was explained by Parthiban, and Ramesh [4].

Also, the bed linen treated with the softener C ($40gL^{-1}$) need a larger amount of heat flux to maintain the skin temperature constant, hence can be classified as being cooler. These results reinforce the results drawn from the analysis of the thermal conductivity and thermal resistance.

CONCLUSIONS

From the results it can be conclude that:

- commercial formulations of polyethylene differed substantially in terms of the effect caused in the material.
- comfort related properties of the material are changed by polyethylene softener application and depending on formulation and concentration.
- silicone softener influence the properties related to the mechanical properties of the material.
- Final studies were carried out on dry thermal manikin, showing that no significant differences were observed on bed linen with the use of different polyethylene formulations of softeners, in terms of thermal comfort.

FUTURE WORK

The conclusions of this work still need validation in terms of tactile perception by consumers and will be the next step of this research project.

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KEYWORDS

Bed linen; fabric softeners, thermal properties, mechanical properties, thermal manikin

