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Volume Electrical Resistivity of Flax Single Jersey Weft-Knitted Fabrics

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INTRODUCTION

As textile materials are typical dielectrics (insulators), with very high electrical resistance, contacts and/or friction of textile materials with non-fibrous and fibrous materials cause the appearance of static electricity. The generation and difficult dissipation of static electricity from textile materials is connected to the high electrical resistance of materials. The electrical resistance of textile materials depends on several factors: raw material composition, moisture content in fibers, electrolyte content, air humidity, temperature, and polarization effect [1]. Furthermore, alkali modification and oxidation of fabrics [2], washing/drying cycles [3], softening [4], coatings with different substances [4], thermal fixation of woven interlining on the woven fabrics [5], as well as abrasion of textile materials change their electrical resistance [6]. In the available literature, no attention has been paid to the influence of pilling on the electrical resistance of knitted fabrics. Therefore, the aim of this study was to evaluate the influence of structural characteristics of knitted fabrics (number of courses, mass per unit area, and thickness), atmospheric conditions (relative air humidity and temperature), and pilling on the volume electrical resistivity of knitted fabrics.

MATERIALS

The three plain single jersey weft-knitted fabrics, produced from the same flax spun yarn with a linear density of 27x2 tex, were used as experimental material. Some structural characteristics of the investigated knitted fabrics are given in Table 1.

Table 1: Structural characteristics of the investigated knitted fabrics

Structural characteristics	Sample 1	Sample 2	Sample 3
Number of wales, cm^{-1}	7.0	7.9	8.0
Number of courses, cm^{-1}	7.2	8.4	10.1
Stitch density, cm^{-2}	50.4	66.4	80.8
Mass per unit area, $g \cdot m^{-2}$	189	211	226
Thickness, mm	0.726	0.769	0.779

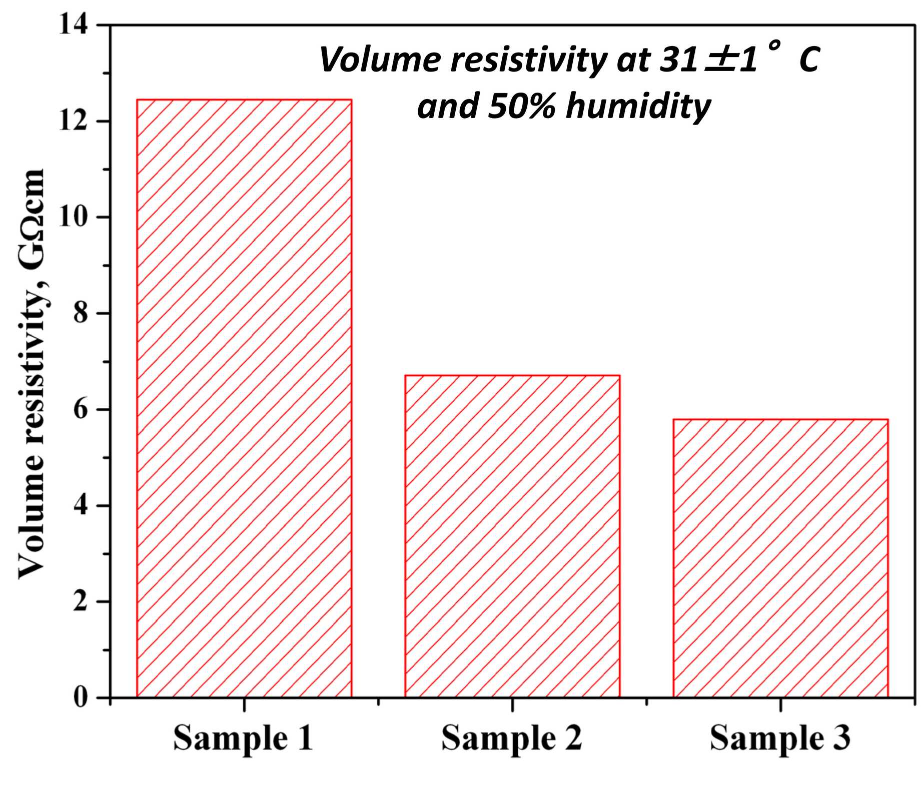
METHODS

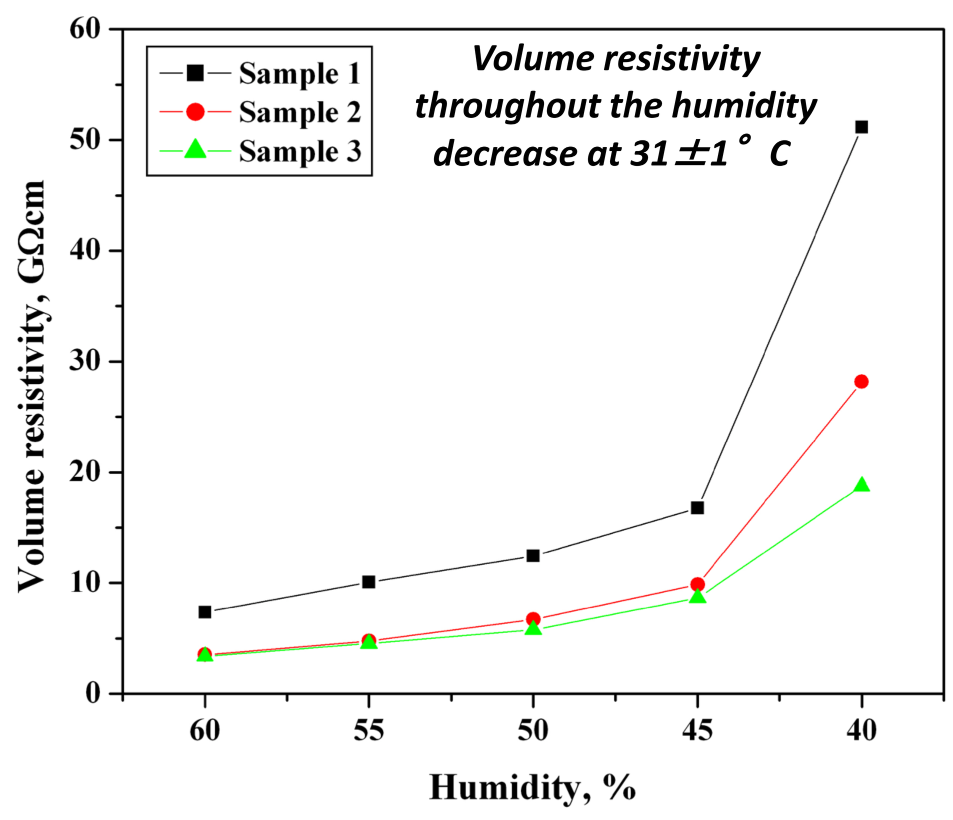
The number of fabric wales, the number of courses, and stitch density were determined according to standard EN 14971:2006 using Method A. Fabric mass per unit area was determined by measuring the mass (in g) of samples whose surface area is 10 cm^2, and by expressing mass in $g \cdot m^{-2}$. The thickness of knitted fabrics was measured at a pressure of 9.96 kPa using a thickness tester (AMES, type 414-10, USA). All measurements were realized at 31±1° C and 40% relative air humidity.

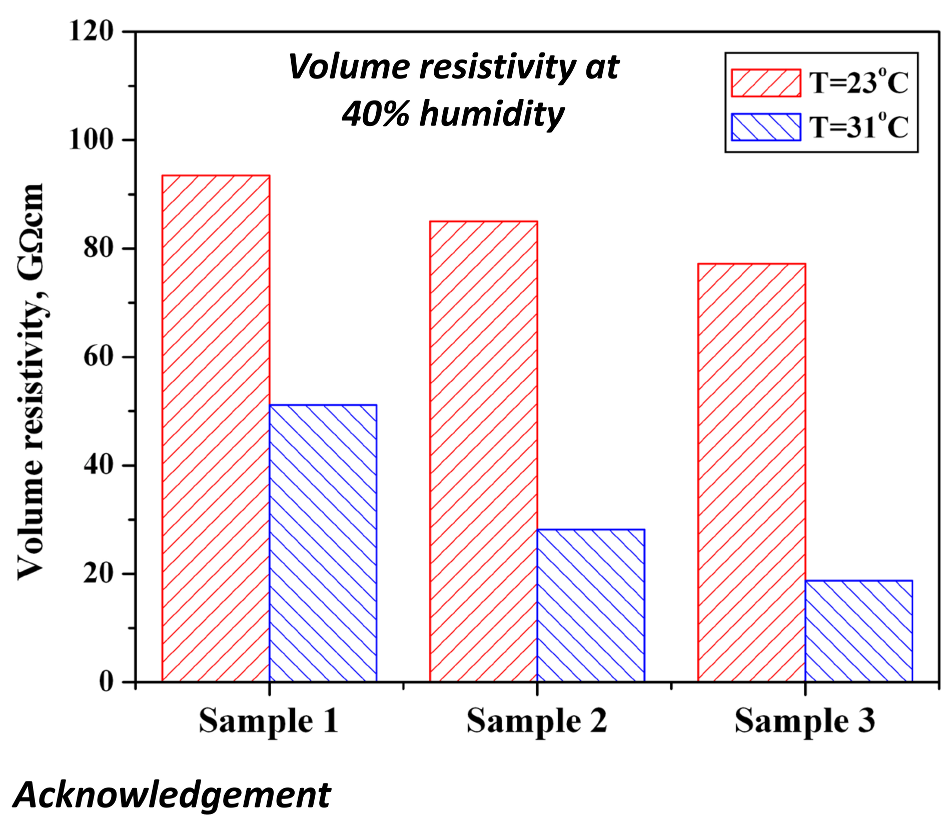
Investigated knitted fabrics were subjected to pilling using SDL ATLAS M235 Martindale Abrasion and Pilling Tester. Pilling was performed at 7000 rubs using the same knitted fabric as abrasive materials.

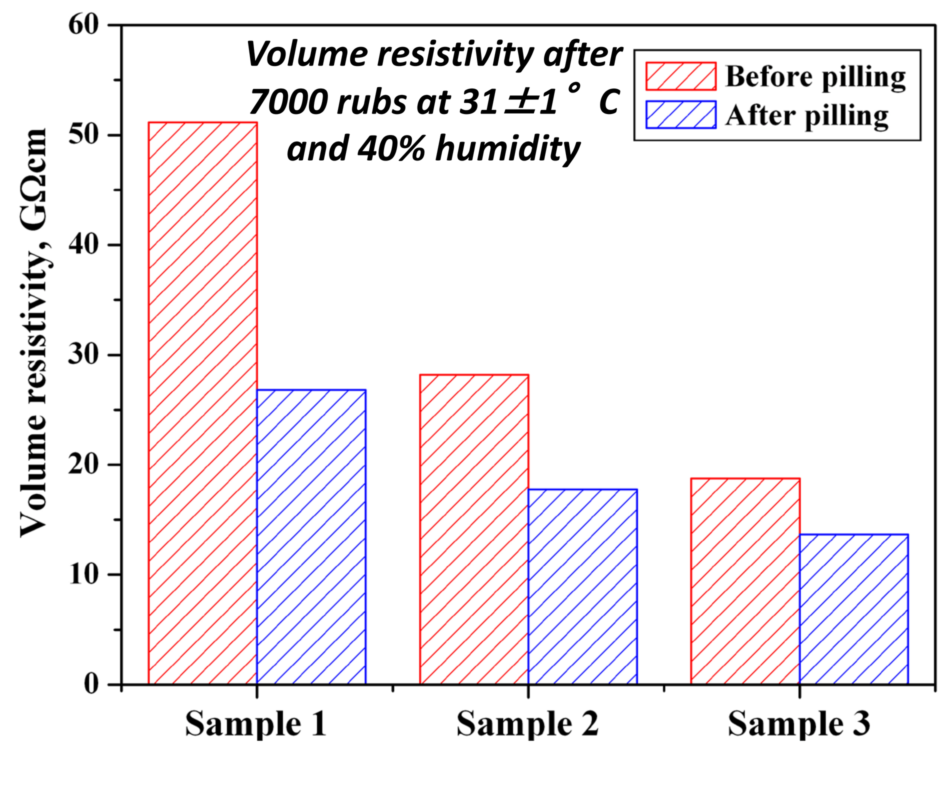
The volume electrical resistance of the investigated knitted fabrics was determined in the course direction using the voltage method [7]. The measurement was performed under the decrease of the relative air humidity in the chamber (from 60% down to 40%) at room temperature (31±1° C) for samples before and after pilling, as well as at 40% humidity and 23±1° C for samples before pilling. Based on the determined knitted fabric volume electrical resistance, the volume electrical resistivity of samples was calculated before and after their pilling [7].

RESULTS









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CONCLUSION

The lowest value of volume resistivity has the knitted fabric with the highest number of courses, mass per unit area, and thickness. The highest values of structural characteristics ensure the easiest flow of directional movement of charge through the sample which leads to the decreased volume resistivity. Volume resistivity of knitted fabrics was higher at 40% humidity than at 60% humidity for about 5.5 times up to 8 times. An increase in the temperature from 23° C up to 31° C is accompanied by the decrease in the knitted fabrics' volume resistivity due to an increase in mobility of water molecules with an increase in temperature. The highest decrease in volume resistivity, with an increase in the temperature, has knitted fabric with the highest values of all structural characteristics (Sample 3). Furthermore, there is a decrease in the volume resistivity after pilling for all knitted fabrics from 1.9 times down to 1.4 times, probably due to surface fuzzing. Formed fuzz, which fills the space between the loops, allows the easier flow of directional movement of charge thus decreasing the volume resistivity of all knitted fabrics.

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