SHAPING THE LIQUID MOISTURE TRANSPORT PROPERTIES OF COTTON FABRICS BASED ON THEIR STRUCTURAL PARAMETERS

(KSZTAŁTOWANIE WŁAŚCIWOŚCI TRANSPORTU PŁYNNEJ WILGOCI TKANIN BAWEŁNIANYCH W OPARCIU O ICH PARAMETRY STRUKTURALNE)

ABSTRACT

The aim of the work is to create theoretical basics enabling the shaping the biophysical properties of fabrics in the field of liquefied transport from the skin of the clothing user to the environment. This goal is to be achieved by analyzing the transport of liquid moisture in fabrics with a structure different in terms of weave, linear density of the warp and weft, and weft density. The topic of the work is closely related to the issue of psychological comfort during clothing usage.

The thesis of the work is as follows:

By appropriately selecting the weave, yarns and structure density, it is possible to shape the transport of liquid moisture in fabrics, in the context of removing condensed sweat from the skin of the clothing user to environment.

Studies of liquid moisture transport are not very common, mostly based on measurement of the contact angle and capillary phenomenon. The Moisture Management Tester (MMT) M290 by SDL Atlas, which was used in the research, allows for a more complete, multi-aspect analysis of the phenomenon of liquid moisture transport in textile materials. The research works published so far are usually devoted to the issue of moisture transport in knitted fabrics. However, research on fabrics in this area is sporadic. These are not systematic studies, but rather case studies. There is no theoretical basis for designing fabrics that ensure efficient transport of liquid moisture.

This work reviews the literature on research conducted so far on the phenomenon of moisture transport in liquid form, research methods that are used and the role of cotton in clothing production. The biophysical properties of textile materials and individual types of comfort are discussed. Special emphasis was placed on physiological comfort, which is one of the main topics of this work. The following sections of the work describe issues related to moisture transport in textile materials and describe known research methods in this area.

In the PhD thesis 27 cotton fabrics with different structures were tested. The diversity of structure was the starting point for analyzing the fabrics in terms of their ability to transport moisture in a liquid form. The fabrics analyzed were made on the basis of two warp yarns of linear density of 50 tex OE (*Open End*) and 60 tex OE. Five types of weft yarns with a linear density of: 30 tex, 40 tex, 50 tex, 60 tex, 100 tex. Six types of weave were used in the tested fabrics: plain, twill 3/1 S, twill 2/2 S, rep 1/1 (0,1,0), rep 2/2 (2) and hopsack 2/2 (0,2,0). Additionally, the fabrics differed in the weft density: 11/cm, 9/cm and 7/cm.

Measurement of liquid moisture of transport was performed using the MMT M290 device from SDL Atlas. The statistical analysis of the obtained measurement results was performed using the STATISTICA software from TIBC® Statistica™.

An experiment plan was developed in which groups and pairs of fabrics were compared, taking into account their different structures.

The experiment plan included six stages:

- Stage I – analysis of the influence of the weave and the linear density of the weft yarn on the parameters characterizing the transport of liquid moisture in fabrics,
- Stage II – analysis of the influence of weave and weft density on parameters characterizing the transport of liquid moisture in fabrics,
- Stage III – analysis of the influence of the linear density of weft yarn on the parameters characterizing the transport of liquid moisture in fabrics,
- Stage IV – analysis of the influence of the weave and linear density of the warp on the parameters characterizing the transport of liquid moisture in fabrics,
- Stage V – analysis of the possibilities of using the artificial neural networks to predict the transport of liquid moisture in fabrics,
- Stage VI – analysis of liquid moisture transport in fabrics subjected to repeated wetting.

To summarize the analysis of the measurement results in stages I – IV, it can be stated that:

- the type of weave and the linear density of the weft yarn have a significant impact on the development of liquid moisture management parameters, the weave and linear density of the weft yarn, as well as the interaction between these two factors, have a significant impact on the development of the values

of these parameters at the significance level of 0.05 in relation for most parameters,

- weft density affects the share of fibrous material per unit of fabric area. In the case of cotton fabrics, the fibrous material is hydrophilic; the higher the proportion of cotton fibers is, the higher the absorption of liquid moisture by the fibers,
- the use of weft yarn with a higher linear density while maintaining other structural parameters of the fabric (linear density of warp, warp density, weft density and weave), causes deterioration of the fabric's properties in terms of the transport of liquid moisture; the liquid is distributed more slowly over the fabric surface and therefore evaporates more slowly.

To summarize the analysis of measurement results using artificial neural networks, it can be concluded that it is possible to use artificial neural networks to predict the ability of cotton fabrics to transport liquid moisture. The generated artificial neural networks allowed to satisfactorily predict the values of most parameters characterizing the transport of liquid moisture in cotton woven fabrics.

The tests on repeated wetting of fabrics showed that subsequent wetting cycles change the values of all parameters characterizing the ability of fabrics to transport the liquid moisture. In most cases, the effect of the number of wetting cycles, and therefore the amount of liquid moisture dispensed onto the fabric surface on its ability to transport liquid moisture, is statistically significant at a significance level of 0.05.

Summarizing the research conducted and the analysis of the results, it can be said that the thesis of the doctoral thesis has been fully confirmed.