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APLICATION OF BREATHABLE AND ODORLESS LINING TO ORTHOPAEDIC SHOES

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KEYWORDS
Orthopaedic footwear, breathable membranes, comfort, textile finishing.

ABSTRACT

The main purpose of this work is to apply new materials and new finishing to improve comfort in orthopaedic footwear associated with orthosis. This desideratum will be reached through the selection and application of advanced materials, such, breathables membranes and fabric finished with anti-fungal and anti-bacteria treatments. In this work, water vapor permeability was evaluated to determine the transport property of water vapor produced by transpiration of the skin. A new lining with breathable membrane and anti-odour finishing has been developed and tested. Water vapor permeability of the new lining was compared with a commercial leather lining, commercial lining with breathable membrane - AquaStopT, breathable membrane and weave fabric. The possibility to use fabrics with anti-odour finishing's, laminated with a hydrophilic breathable membrane, for lining proposes has been demonstrated. Application of membranes with weave fabric by lamination decreases the breathability of materials, nevertheless, the lining with hydrophilic (LF) membrane and the leather's lining have similar values for water vapor permeability, with the advantage that LF is impermeable.

INTRODUCTION

Over the last few decades a number of research works have been done in this field of new materials and new production techniques, directly related to the orthopaedic footwear. However, the developments of orthopaedic footwear associated with orthosis did not got enough attention, in which the only relevant aspects are the robustness and durability of the system's elements. Other important issues such the application of new advanced materials to achieve functionality and give better aesthetic values, are neglected. In orthopaedic footwear as a consequence of intense utilization the problem of bromidrosis is particularly important.

The comfort properties are ensured by the water vapor permeability of materials. In most of the cases the breathability of footwear depends of the materials proprieties, namely upper shoe parts, linings and vamp, and the capability of midsole absorb/release water. The breathable properties of materials helps to reduce or eliminate the bromidrosis problem.The development of bad odours or bromidrosis is due to proliferation of bacteria and fungi, when inside the shoes are stablished the ideal conditions of temperature and humidity for their proliferation (Pinto 2006).

The usual material to produce orthopaedic shoes is leather because this combines different proprieties like breathability, softness and ability to get to foot form (Garcia et al 2010). Even so, leather is not a waterproof material and it doesn't ensure a good breathablity to the foot.

The latest developed materials which owns this desired properties are breathable membranes.The breathable membranes are polymers films which presents a good permeability, letting the water vapor go out and nevertheless be impermeable to liquids (Lomax 1990**).**

Two different types of breathable membranes can be applied on lining shoes, micro-porous and a hydrophilic. The micro-porous membrane have millions of micropores per square inch. These are too small to allow passage of liquid water but with sufficient size to allow passage of molecules of water vapor (20,000 times smaller than liquid water and 700 times larger than a water molecule) thus permitting breathability skin **(**Fung 2002**).**

The hydrophilic membranes are nonporous membranes and the water vapor is transmitted by a molecular mechanism. (Gulbiniené 2007**).**

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In this work textiles laminated with polymer membranes have been applied as lining to orthopaedic shoes. The high capacity of breathability of polymer membranes is the core aspect to increase comfort.
With this lining a barrier to water is created but it's still vapor permeable. In that sense the sweat can be transported through the lining. This laminate textile in association with an anti-odour finishing´s can reduce or eliminate the bromidrosis

MATERIALS

The sample (LF) used in this study were prepared, with three layers (weave fabric/hydrophilic membrane/weave fabric), by a laminating process.The layer in contact with the skin is finished with anti-odour treatement.
The waterproof and breathable proprieties of the linning were obtained by utilization of a hydrophilic membrane, to increase moisture vapor transmission properties In this research study a compared between the proprieties of the lining developed and several materials commercial: Leather Lining (LL), Lining With Breathable Membrane AquaStopT (AQUA), Breathable Membrane (BM) and Weave Fabric (WF).

METHODS

Water vapor permeability were evaluated according to "British Standard 7209-British Standard Specifications for Water Vapor Permeable Apparel Fabrics". To determine the transport property of water vapor emitted from the skin and it is calculated by following equation.

The Water Vapor Permeability (WVP) in g/m^2/day is given by the Eq. (1)

$$WVP = \frac{24M}{AT} \quad (1)$$

Where [M] is the loss in mass of assembly over the time period t [g],
[T] is the time between successive weightings of the assembly [h],
[A] is the area of exposed test fabric - equal to the internal area of the test dish [m^2].
The water permeability Index [I] is given by means of following Eq. (2)

$$I = \frac{(WVP)f}{(WVP)r} X100, \quad (2)$$

In witch the (WVP)f is the mean water vapor permeability of the fabric under test and the (WVP)r is water vapor permeability of the reference fabric and three samples, with 96 mm diameter, for each material were tested.

RESULTS AND DISCUSSIONS

To confirm the purpose of the developed lining, the water vapor permeability of laminated fabric was compared with a breathable membrane, weave fabric, commercial leather lining and a commercial lining with breathable membrane AquaStopT.

Table 1 shows the differences of Water Vapor Permeability Index.

Table1 – Comparation of different Materials

Samples	BM	WF	LL	LF	AQUA
WVP(%)	95.8	94.7	69.3	69.2	46.4

It is possible to verify the application of membrane to weave fabric (lamination process) decreases the breathability of materials.Nevertheless, the LF and the lining leather have similar values for WVP index; with the advantage that LF is impermeable.

CONCLUSIONS

It can be concluded that it's possible to use hydrophilic breathable membranes with weave fabric to obtain an impermeable lining. It can be applied anti-odour finishing in this LF. It can be concluded that these new materials can be used to improve breathable and waterproof in orthopaedic footwear.

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