Textile Materials for Sports Footwear and Its Desirable Characteristics

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Abstract— Textile materials have been widely used for sports footwear. Characteristics of materials are very important in determining the performance of sports footwear. Firstly studies the various materials are used as a component of sports footwear are summarised. Secondly, an overview on the desirable characteristics of materials used in sports footwear performance is done to better meet the need of the foot.

Key words: Textile Materials, Sports Footwear

I. INTRODUCTION

Textile materials used in sports footwear play a predominant role in determining their suitability for sport footwear functions. Features of sports footwear are protection, shock absorption, performance, and comfort. [1] The primary function of all types of sports footwear is to provide the protection the feet with a firm hold and from injury and improve sporting performance.[2] Comfort relies on a mix of tactile, thermal and biomechanical features that have to be built into the shoe to provide support, shock absorbency and warmth.[3]Optimal functionality of sports footwear is achieved through the correct design of upper and lower part of shoes, correct technically chosen materials and components and correct shoes construction.

II. MATERIAL FOR SPORT FOOTWEAR

The technical textile components typically used in the sports shoes are as follows:

- Shoe uppers made of PU/PVC coated/Laminated fabrics.
- Linings on the counters and below the shoe uppers.
- Others include non-woven insoles, laces, tapes, labels, elastics, sandwiched meshes, etc.[5]

A. Material for The Upper:

The basic raw material for textile production is fibre. It can be natural or man-made. Man-made fibres are synthetic and natural polymer based. For the upper and lining of the sports shoe, woven, knitted and non-woven textiles are used. The fabric has two to four layers constructed from different textiles which are laminated by adhesive or by foam. In footwear upper and lining materials most often, fibres in woven textiles are polyamide, polyester, polypropylene and polyethylene. Plain and twill weave structures are most often used. To give durability and strength, Knitted textile is often used as a backer. Nylon is a common fibre used in the lining and upper textiles. Textiles are also used coated with PU (polyurethane) and with PVC (polyvinylchloride) films. PU and PVC films are flexible, durable, protective and decorative. To support the synthetic film, woven textile and nonwoven backers are used. Microfiber as a material has similar properties to leather and is elastic and resistant to tearing, splitting and abrasion. Microfiber is also permeable to vapour and it is breathable. It is used in many types of sports shoe upper pieces. Other materials used for sports shoe uppers are rubber and moulded PVC. Rubber uppers are waterproof and a PVC mould dip technique is used for skates and ski boots. [1]

The material needs: flexibility, tensile strength, and durability against rubbing and flexure. It should allow the foot to breathe while being waterproof. To protect the foot from abrasion and contact injuries is the most important requirement for the upper. Its flexibility is more important, especially in the frontal region so lightweight constructions are used. [4]

B. Material for Linings:

To protect the foot and enhance comfort, the inside surfaces of the upper are often lined with special materials. In footwear leather, cotton and man-made synthetics such as tricot and vinyl were the most common lining materials used, although leather linings are done in sports shoes. Cotton, though very absorbent, wears poorly because fungi and bacteria penetrate the material and eventually cause it to rot. The fungi and bacteria will also foster foot odor. These limitations make it a poor choice for sports shoe lining. Tricot has been very popular in shoe linings in the past because it is inexpensive. But it does not wear well and tends to promote a hot and humid environment inside sports shoes. Other man-made fabrics cause these very same problems because they are impermeable. Non-wovens usually have an extremely high resistance to fungus, rot, chafing, and cracking. This combination of benefits has made the non-woven materials a very good choice for shoe lining. [1]

C. Material For Shoelaces And Other Closures:

Shoelaces are made of cotton, nylon or polyester braided or woven. Other more specialty fibres are sometimes employed. For example, the use of Kevlar fibres in lacing some specialist mountaineering products for added strength and durability. [1]

D. Material for The Sole

1) Footbed:

Textiles are used as top covers on footbeds, or as they are sometimes called insoles. Stretch nylon, polypropylene, or polyester fabrics which are laminated to the top of the foot bed's foam core the most common materials chosen for this application. The most functional top cover material is a four-way stretch nylon. On the plantar surface of the foot, Stretch materials seem to reduce blistering. Another functional category of textiles used in the footbed is non-woven materials, used to keep the sole of the foot dry. These materials also sometimes have anti-microbial treatments to discourage the growth of bacteria and fungi inside the shoe. [1]

2) Strobel Layer:

Textiles are also quite commonly used in the so-called Strobel layer. Modern sports shoes construction techniques most often use a flexible material as a boundary layer between the upper and the midsole called a Strobel board. In fact, the

Strobel board is not a board at all but a flexible and sometimes deformable layer of non-woven material or fabric that is stitched along its border to the body of the upper. [1]

III. MATERIALS DESIRABLE CHARACTERISTICS TO BATTER MEET THE NEED OF FOOT.

A. Thickness of Upper:

The thickness of upper determines the thickness according to ISO 4648:1991 method, using a thickness gauge with a flat presser foot of 10 mm diameter and a load of 1 N. The thickness of the upper shall include any associated textile layer.

B. Breathability of Upper And Liners:

A significant amount of metabolic energy and sweat is released by the human body. The physiological tolerance to cold varies in a wide range from one person to another. The duration of the exposure to cold, the level of physical activity, and the rate of sweating determines whether the person feels warm and comfortable or cold and uncomfortable. [6] The average human foot produces 2.3–3 g of sweat per hour at rest. During walking the amount of sweat produced by the foot increases significantly, up to an average of about 7 g of sweat per hour. During hard physical work in a hot environment, this figure may rise to about 15 g per hour. [7]The foot also affects the microclimate via heat loads generated metabolically by the intrinsic foot muscles and by heat carried by the blood vessels of the foot. Also, some heat is created by friction between the foot and shoe, especially at the foot-sock footbed interface. [1] So, dissipation of heat generating from foot and air permeability of upper is required.

1) Air Permeability:

Determination of air permeability of textile is done as per ISO 9237:1998.

2) Heat Resistance and Water Vapour Resistance:

PN-EN 31092:1998 method is used to determine the physiological property –measurement of heat resistance and water vapour resistance at study state condition for textile materials.

C. Durability Of Upper And Liner:

Most sports make intimate mechanical demands of their athletes' footwear. Force, mass, and acceleration are the names of these demands. Footwear components such as the upper, vamp, quarter, laces, and heel counter must be designed to deal with extreme lateral forces such as those exhibited by players. [1]Durability of the materials are determined by physical properties of materials.

1) Tear Strength:

Tear strength of the upper has been determined in accordance with EN ISO 20344. According to this method, minimum tear strength of upper coated materials is 60N.

2) Tensile Strength:

Tensile properties of the upper material have been determined according to EN ISO 20344: 2004 method. Minimum tensile strength is 15 N/mm2.

3) Flexing Resistance:

Determination of the upper flexing resistance according to EN ISO 20344: 2004. According to this method, minimum flexing resistance of materials is No cracking before 125 000 flexes.

4) Abrasion Resistance:

Abrasion resistance tested in accordance with EN ISO 20344: 2004, the lining shall not develop any holes before the following number of cycles has been performed:

Dry: 25 600 cycles;

Wet: 12 800 cycles.

5) Breaking Strength:

Breaking strength of materials has been determined by IS 1969 method. Minimum breaking strength is 40 kg/50mm.

D. Colour Fastness:

Colour fastness is an aesthetic property of materials which give a good appearance of materials. When same colours are applied by different methods - dyeing or printing method it gives the different appearance of materials. So colour fastness is measured by IS 766-1989 method. Colour fastness in dry and wet condition minimum is 3-4.

IV. CONCLUSION

Materials used in sports footwear as upper, liner and in the sole should have protective properties. Materials have thermal regulation and thermal comfort properties as air permeability, heat transfer, moisture transfer, water vapour permeability to maintain the microclimate condition in the inside of the shoes. In biomechanics of foots, most sports make more immediate mechanical demands of their athletes' footwear. Force, mass, and acceleration are the names of these demands. So Materials should have physical properties like tear strength, breaking strength, tensile strength so that materials withstand exerted force by players.

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