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Dynamic Fatigue of Plain Knitted Fabric

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ABSTRACT

A new dynamic fatigue tester simulating knitted fabric deformation during use is proposed in this paper. An image processing device was developed and used to model the loop geometry of a plain knitted fabric. Based on the analysis of existing plain knitted fabrics, the geometrical modelling of knitted loop propose the combination of different mathematical functions to describe the loop geometry. A plain knitted fabric made of cotton commonly used in the clothing industry was tested with the fatigue device at different cycles and then relaxed. Repeated elongation involved permanent deformation depending on relaxation and number of cycles. The origins of dimensional behaviour of knitted fabric after fatigue test were discussed.

Keywords: fatigue test, plain knitted fabric, image processing, permanent deformation, relaxation

1. Introduction

Plain weft knitted fabrics from cotton are very popular in clothing industry. Cotton, being a non thermoplastic fibre, is unable to be heat set. Dimensional properties of this category of knitted fabric is widely affected by external applied forces that could involve permanent deformations. Repetitive elongation is a very common form of deformation in textile materials and especially in knitted structures. Knitted fabrics employed in clothing undergo a very large number of elongations when putting the apparel on or during body motion. The loss of elasticity during use is one of the most important problems that could affect the long-term reliability of knitted garments such as underwear and sportswear.

At present, there is no any standard or official procedure permitting to measure permanent deformation involved by a very high number of cyclic elongations that simulates the use of a knitted garment. Several works in the past have examined the dimensional behaviour of knitted fabrics at rest or under constant forces. The key element is the geometry of the knitted loop. Pierce [12], Leaf [7,8,9], Doyle [4,5], Munden [11], Postle [14], Derminoz *et al.* [3], Araujo *et al.* [1], Semnani *et al.* [15] and Choi *et al* [2] have significantly contributed to the geometric analysis of plain knitted fabric. But in most cases, the plain knitted fabric was described with very simple geometrical shapes such as arcs of circle and segments.

Alternatively the dimensional properties of knitted fabrics were studied by some researchers using the force method. In the theoretical models of Postle *et al.* [13], and Hepworth *et al.* [6] yarn was treated as a