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Evaluating Hand Properties of High Counts and High Density Fabrics

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Abstract

Fabric hand is defined as the human tactile sensory response towards fabric, which involves not only physical but also physiological, perceptional and social factors. Fabric hand is one of the most important characteristic of a fabric. This paper discusses the relationship between technical features of high counts and high density fabrics and their hand evaluation. 13 samples of high counts and high density fabrics were selected to be measured by the Kawabata Evaluation System (KES). The range of the mechanical properties of high counts and high density fabrics was given. Using factor analysis with quartimax rotation, 5 factors model was generated. The relationship between the 5 factors and the technical features was shown by using correlation analysis. The study in this paper can offer references for the quality control of high counts and high density fabric design.

Keywords: Fabric Hand Evaluation; KES; Factor Analysis; High Counts and High Density Fabrics

1 Introduction

The phenomenon of the fabric hand is one of the most significant characteristics in determining fabric marketing and in providing the fabric scope of end-uses, performance, and appearance. It is related to basic mechanical properties of fabrics and it expresses some apparent characters and internal quantities. Fabric hand usually means the tactile comfort when someone touches fabrics and it also contains visual sense comfort and audio sense comfort universally [1, 2].

Fabric hand could be evaluated subjectively and objectively. Since fabric hand mainly refers to tactile comfort, people judge fabrics by touching them naturally. However, many studies indicated that the subjective evaluation was not consistent in different countries and different culture [3, 4]. Subjective hand evaluation of the same fabric is usually different. As it is widely recognized that subjective techniques are unable to meet the requirements of a very diverse marketplace or to overcome the loss of expertise in assessing fabrics caused by the retirement of experienced employees. Peirce [5] started to measure fabric hand objectively in the 1920s. He identified fabric bending properties as key component of hand, or more correctly of fabric stiffness, and

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developed a number of tests to measure fabric rigidity in bending. Since the initial work of Peirce, a large number of individual instruments have been developed to measure a number of properties under the low stress conditions consistent with the measurement of hand [6]. The most influential system was the Kawabata Evaluation System (KES) designed by the Hand Evaluation and Standardization Committee (HESC). The first machines of KES was released in Japan in 1972 [7]. Later models, called the KES-FB series, were released in 1978 and were designed to reduce the time required for specimen preparation and testing [8]. By 1984, the system had been adopted in Japan and, to a lesser extent, worldwide. A series of formulas for the prediction of fabric Total Hand Value (THV) were also given by HESC. The KES system was made up by shear/tensile tester, bending tester, compression tester and surface tester, 17 mechanical properties (including fabric weight measured by balance) can be evaluated. This system has been used in extensive fields such as not only objective evaluation of fibers, yarns and fabrics, but also textiles and allied industries, paper industries, etc. [9]. In the 1990s, a new system called Fabric Assurance by Simple Test (FAST) was released in Australia. The concept of the two systems are both based on the determination of the mechanical response of fabrics to low stresses. The reason on designing this system is to enable the appropriate parameters to be measured as quickly as possible with high accuracy and good reproducibility [10]. A new instrument called PhabrOmeter was introduced by N.Pan in 2010, it can measured 7 aspects of fabric hand [3].

The KES was widely used in the world while the formulas given by HESC are scarcely used, it is because the THV predicted by these formulas were based on the subjective evaluation of Japanese scientists. Researchers analysis these mechanical properties measured by KES in different mathematical methods, such as factor analysis, regression analysis and neural network [11-14].

2 Materials and Measurements

2.1 Materials

High counts and high density fabrics were popular among consumers because of their good tactile comfort and silky feel. In order to study the relationship between the technical features and their hand evaluation, 13 samples were selected to be measured by the KES. The technical features of 13 samples were shown in Table 1. These samples were produced by LuThai Group, China and usually used for the production of high-grade shirt.

As shown in Table 1, the samples all belong to high counts and high density fabrics and are all plain woven fabric.

2.2 Measurements

Every sample was placed in a controlled room with a temperature of 20 ± 2 °C, a humidity of $65 \pm 3\%$ for 24 hours and measured for three times by the KES to make sure the consequences were reliable. As the measurement can cause damage to the fabric, we took the order of surface testing, compression testing, bending testing, tensile testing and shearing testing.

According to the 26 mechanical properties provided by the KES instruments, the maximum value, minimum value, mean value and standard deviations of mechanical properties of high