A Correlation Study of Subjective Sensorial Evaluation and Objective Softness Measurement of Wool Fabrics

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Abstract: Comfort is one of the most important aspects of clothing, especially for next-to-skin garments such as shirts and trousers for summer. Sensorial comfort has a strong relationship with both the mechanical and surface properties of apparel fabric. A comfortable textile material should have properties of softness, smooth surface or texture, be pleasant to touch and very flexible. When assessing fabric handle subjectively, the assessor usually strokes the fabric surface with one or several fingers and squash the fabric gently in hand. Thus, the perception of such handle includes complex parameters of compression, tactile sensation and textural effect. In this work, we attempted to use a simple technique of objectively evaluating fabric softness related properties, by measuring the force required to pull a fabric strip through a series of parallel pins (the pulling force). We also subjectively rated the fabric handle. The correlation analysis showed very good agreement between the fabric pulling force and subjective hand rating.

Keywords: subjective handle; softness; wool fabrics

1 Introduction

The tactile property of a fabric is one the most important characteristics that affect the quality of apparel products and so influences the consumer's decision-making process in purchasing textile clothing. Several marketing studies point out that modern consumers consider the tactile sensory evaluation being one of the most important attributes in their purchase of textiles [1]. While extensive research has been conducted to measure the fabric touch property, quantifying the tactile sensations in a quick and universal way still remains a considerable challenge [1-3].

Sensorial or tactile comfort, often simply identified by "hand or handle", is essentially a result of how much stress is generated in the fabric and how it is distributed over the skin and therefore has a strong relationship with both the mechanical and surface properties of the fabric. There is quite a difference in fabric handle preferences from individual to individual due to differences in consumer cultural background and/or climatic differences and sometimes preferences may even be opposite [4]. Objective measurement of fabric handle will help consumer to choose their preferred fabric products.

Traditionally, the quality and surface characteristics of apparel fabrics are evaluated by touching and feeling by hand, leading to a subjective assessment. When assessing fabric handle subjectively, the assessor usually strokes the fabric surface with one or several fingers and squash the fabric gently in hand. Therefore, the perception of such handle includes complex parameters of compression, tactile sensation and textural effect.

The trend for light weight fabrics has significantly influenced the recent evolution of the wool textile industry, since the weight of traditional woven fabrics for jackets and suits has decreased continuingly and probably irreversibly. The wool products have become suitable for all the seasons including spring and summer. Therefore, this paper intentionally studied light weight wool fabrics.

To measure fabric handle, this study employed a simple technique for objectively evaluating fabrics softness by pulling a strip of fabric through a series of parallel pins. This method was developed to evaluate fibre and fabric softness [5]. Softer fabrics of a lower bending rigidity and smoother surfaces generally result in a lower pulling force, and we expect the same for light weight wool fabrics.

For comparison, the order of softness of wool fabrics used for pulling force measurement was also ranked subjectively. A statistical correlation analysis on the objective and subjective results was carried out.

2 Experimental

2.1 Materials

The materials used in this study were 12 light-weight wool fabrics for summer men suits. These fabrics were made from high quality fine wool, including Italian "cool wool" and they are coded 10, 20, 31, 32, 40, 51, 52, 60, 71, 71, 83, and 85, as shown in Table 1. All fabrics are plain weave structure and were piece dyed (PD), yarn or top dyed (TD). The final dry finishing was the same for all fabrics (Shearing, Continuous Decatizing, Kier Decatizing and Steaming). All samples were prepared and tested under the standard atmospheric conditions, 65±2% r.h and 20± 2 °C.

Table 1 Fabric Specifications

Fabric Code	Composition	Yarn Count (tex) Warp x Weft	Mass/area (g/m^2)	Thickness (mm)	Dyeing
10	100% Wool	26,7 x 25,4	142,0	0,411	Yarn Dyeing
20	100% Wool	21,2 x 18,5	130,0	0,420	Top Dyeing
31	100% Wool	25 x 25	137,0	0,404	Top Dyeing
32	100% Wool	25 x 25	142,0	0,408	Piece Dyeing
40	100% Wool	27,5 x 27,5	162,0	0,424	Piece Dyeing
51	100% Wool	31,3 x 31,3	152,0	0,412	Top Dyeing
52	100% Wool	31,3 x 31,3	155,0	0,440	Piece Dyeing
60	100% Wool	23,5 x 19,0	137,0	0,448	Piece Dyeing
71	100% Wool	38,5 x 38,5	189,0	0,557	Top Dyeing
72	100% Wool	38,5 x 38,5	189,0	0,575	Piece Dyeing
83	96% Wool 4% Lycra	32 x 30	179,5	0,581	Piece Dyeing
85	77% Wool 19 % Nylon 4% Lycra	28 x 28	182,6	0,562	Yarn Dyeing

2.2 Objective evaluation

To objectively evaluate the fabric softness, a simple device was used to measure the pulling force of a strip of fabric through a series of pins. Figure 1 shows the experimental set-up. Details of the pin configurations are given in Table 2. The fabric samples were cut into 5 x 36 cm pieces along the diagonal direction and 5 samples were tested for each fabric. A Lloyd material testing instrument (LR30K type) was used to measure the pulling force with a Load Cell of 100N. The test speed was 200 mm/min.

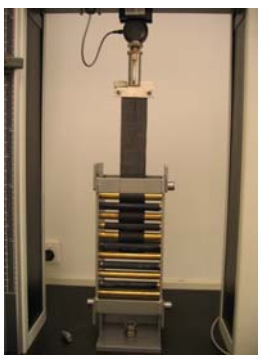

Figure 1 Experimental Set-up

Table 2 Pin Configuration

Parameters	Rig settings
Distance between pins (mm)	5
Pin diameter (mm)	15
Number of metal pins	12

2.3 Subjective evaluation methodology

A sensorial subjective evaluation of the materials, as shown in Figure 2, was conducted using a "paired- comparison method" [6], which enabled us to quantify the preferences of handle sensation by calculating the percentage of the most voted material. With this method we ranked the materials from the very good hand fabric (highly voted) to the poor hand fabric for this group of wool materials. A total of 20 evaluators including textile experts, and textile postgraduate students from Deakin University assessed the fabric handle.

Figure 2 Subjective evaluation of fabric handle (without viewing the fabrics)

3 Results and discussion

Figure 3 shows a typical curve of the pulling force of the samples through the series of pins. There is a deep drop in the force curve around the 15 second because the sample just left the first pin during the pulling process. For the validation of the results, only the average of the values from 5 to 15 seconds was considered for each test.

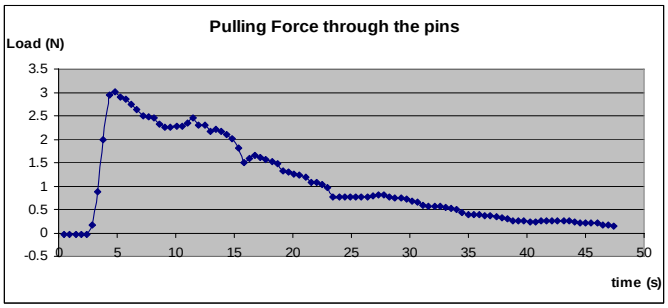

Figure 3 Force curve of pulling a fabric through pins

As expected, Figure 4 shows that the subjective rating scores decrease with the increase in the fabric pulling force. The Italian “cool wool” fabrics (Codes 10; 20; 40; 60), being the finer ones, are those with lower pulling forces and higher subjective handle rating scores.

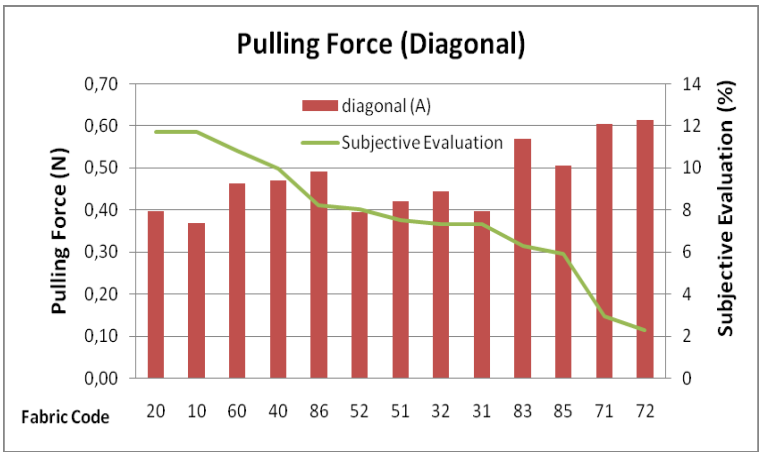

Figure 4 The Subjective Evaluation versus Pulling Force

Figure 5 presents a correlation between fabric pulling force and subjective evaluation vote (%), and the correlation coefficient is significant at the 5% level. The preferences of the evaluators in terms of handle for

"wool fabrics materials for making men summer suits" are essentially: soft, cool, light, smooth and thin. The fabrics that are evaluated as having a better handle are the ones that have lower values of pulling force.

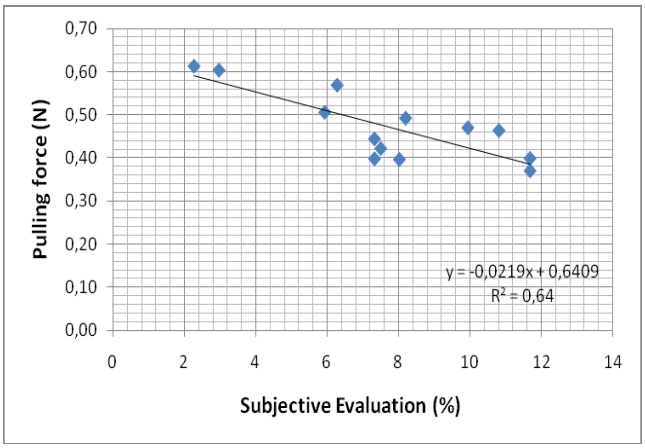

Figure 5 Pulling Force and Subjective Evaluation correlation

4 Conclusions

This research studied the relationship between wool fabric pulling force through pins, which relates to the fabric surface and mechanical properties, and the subjective assessment of sensorial comfort, or "hand", of selected light-weight wool fabrics. A strong statistical correlation has been found between the subjective rating evaluation and the pulling force parameter for the wool fabrics. Work is on-going to further develop this simple method for objective evaluation of fabrics.

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