Assessment of sensorial comfort of fabrics for protective clothing

Conference Paper · May 2016

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7th European Conference on Protective Clothing ECPC

23-25 May 2016, Izmir Turkey

Assessment of sensorial comfort of fabrics for protective clothing

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Key words: workwear, protective clothing, sensorial comfort, fabric hand, fabric touch, Fabric Touch Tester (FTT)

Introduction

Protection and comfort are important issues for protective clothing and an appropriate protection is most of the times detrimental for overall clothing comfort. The tactile or sensorial comfort is related to the mechanical interaction between the garment and the human body. *Fabric Hand* and *Fabric Touch* are two crucial elements that express how consumers experience textiles by touching them with the fingers and respectively by wearing them. Both subjective and objective methods are used to assess the fabric hand and touch. Well-established *objective test methods* such as Kawabata (KES-F), SiroFAST as well as PhabrOmeter®, Handle-O-Meter, etc. [1] exist which characterize the fabric hand indirectly. They measure certain mechanical fabric parameters that are considered to represent components of the hand (e.g. fabric stiffness, compressibility, roughness, bending, etc.), but some of these instruments are complex to handle or expensive. *Subjective methods* (e.g. panel of experts) are time consuming, slow, expensive and most of the small companies cannot afford that.

Within the ongoing CORNET project Touché [2] both subjective methods (e.g. blind tests, questionnaires) and innovative instruments (e.g. FTT, TSA) are employed for assessment of fabric hand and touch. The Fabric Touch Tester (FTT) [3, 4] enables fast and simultaneous assessment of 13 physical fabric indices (e.g. bending, compression, friction, roughness and thermal conductivity) and uses these indices to predict comfort primary indexes such as smoothness, softness, warmness, total hand and total touch. It could be therefore a promising, very fast selection method of fabrics that will eventually lead to clothing with high sensorial comfort. Fabrics with similar weight and thickness were tested aiming at identifying possible significant differences between the samples.

Experimental

Four fabrics currently used as FR workwear (external layer) were tested (Table 1).

Fabric ID	Fabric type	Fabric weight (gsm)	Thickness (mm)
L	Woven fabric, printed	190	0.45
M	Woven ripstop fabric, printed	210	0.37
N	Woven ripstop fabric, kaki colour	210	0.36
O	Woven ripstop fabric, beige colour	210	0.35

The FTT instrument was employed and the following fabric indices simultaneously assessed: BAR (bending average rigidity), BW (bending work), surface friction coefficient (SFC), SRA (surface roughness amplitude), SRW (surface roughness wavelength), CW (compression work), CRR (compression recovery rate), CAR (compression average rigidity), RAR (recovery average rigidity), TCC (thermal conductivity when compression), TCR (thermal conductivity when recovery) and Qmax (maximum thermal flux). These indices are further used to predict comfort primary indexes such as smoothness, softness, warmness, total hand and total touch. *Primary touch* means the subjective (human) feeling when contacting textile samples passively, i.e. wearing, while *primary hand* means the subjective feeling when contacting textile samples actively, i.e. hand evaluation. For each of the four fabrics 20 replicates were tested (e.g. 10 replicates for inside of the fabric and 10 replicates for the outside of the fabric), both in warp and weft direction. The means and variances were calculated and a one-way ANOVA, Tukey test was performed to identify statistically significant differences (95% confidence level) between the samples.

Results

The results showed no significant differences between most of the indices measured by FTT for the samples MNO (with the same weight and similar thickness). However significant differences were found between the samples MNO on one hand and sample L on the other hand. The significant differences are with respect to:

- Bending properties: sample L had higher values for bending average rigidity BAR and bending work BW (inside/outside and weft/warp direction) than samples MNO
- Compression properties: sample L had higher compression work CW than MNO and a lower compression recovery rate CRR and recovery average rigidity RAR than sample MNO
- Thermal properties: sample L has a significantly lower Qmax than the other samples and sample N has a higher thermal conductivity TCC (only inside) than samples LMO
- Friction properties: sample L has a significantly higher coefficient of friction in weft direction at the inside of the fabric and sample M at the outside
- Roughness: sample L is significantly different than the other samples (rougher)

It was also found that sample L is significantly less smoother and softer than the others (inside and outside, active/passive), is warmer than samples MNO and has an the poorest touch and hand. Primary comfort indexes (e.g. Smoothness, Softness and Warmness) of fabrics LMNO are shown in In Figure 1 and 2. A difference is made between these indexes by active evaluation of the sample (e.g. with the fingers) and passive evaluation (e.g. fabric is passively worn) both at the inside (I) and outside (O) of the samples.

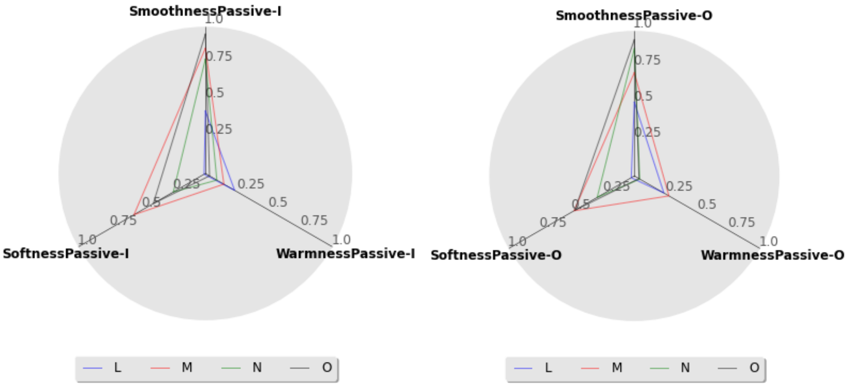

Figure 2 Primary hand indexes of the samples LMNO by passive evaluation of both sides (inside I and outside O)

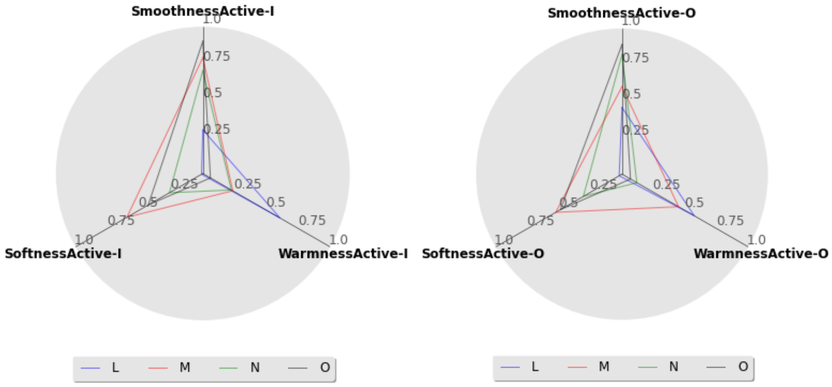

Figure 1 Primary hand indexes of the samples LMNO by active evaluation of both sides (inside I and outside O)

Conclusions

The results showed that the FTT can discriminate between fabrics with very similar weight and thickness. The results were also in agreement with the results of the manufacturer (e.g. their own panel). In the framework of on-going project Touché in-depth subjective assessment of the samples will be performed and correlated with the results of the FTT to assess if FTT is a fast and reliable selection method of fabrics that will lead to an increased sensorial comfort of workwear.

Acknowledgements to VLAIO for financial support of Cornet project TOUCHE (2014-2016)

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