Quantifying Sensorial Benefits of Fabrics

Laure Kyriazis,[1,*] Peter Fryer,[1] Alberto Martinez,[2] Carlos Amador,[3] and Zhenyu Jason Zhang[1]

[1]Centre for Formulation Engineering, School of Chemical Engineering, University of Birmingham, United Kingdom
[2]Procter & Gamble, Brussels Innovation Centre, Belgium
[3]Procter & Gamble, Newcastle Innovation Centre, Whitley Lane, Newcastle upon Tyne NE12 9TS, United Kingdom
*Corresponding author: LXK953@student.bham.ac.uk

Tactile perception of fabrics is affected by the fabric surface's physical and chemical properties. However, conventional force-plate experiments do not provide a complete understanding of the sensorial properties given by different fabric treatments. A novel approach combining acoustic emission (AE) in high frequencies and frictional data was investigated, AE being more sensitive and easier to implement. A good correlation was found between the Root Mean Square (RMS) of the acoustic signal and the Coefficient of Friction (COF) acquired upon the sliding movement of a human finger on treated fabrics, the use of softener reducing both the COF and the RMS.

Keywords (from 3 to 5 max): Skin Tribology, Tactile Perception, Acoustic Emission.

1. Introduction

The investigation of the role of skin friction against fabrics in regards of tactile perception is a trending topic in skin tribology, aiming for better designed products enhancing sensorial properties. Fabric surface and frictional properties rely on the complexity of the combination of a wide range of fibre materials, fabric construction and finishing. Such properties strongly influence the tactile properties of the different fabrics, with a lower skin-fabric friction being preferable for a pleasant tactile perception. Lower skin-fabric friction can be provided by deposition of chemicals such as fabric softeners [1]. Skin friction measurements can provide an objective method to evaluate tactile perception while overcoming panel testing subjectivity. Nevertheless, the use of acoustic emission can be advantageous due to its greater sensitivity and adaptability. In this extent, the correlation of acoustic emission with friction, simultaneously acquired, has been investigated.

2. Methods

Continuous reciprocal sliding movements of human finger in contact with treated fabrics were studied, acquiring simultaneously tribological (Forceboard, Sweden) and acoustic emission (Vallen, Germany) data for varying applied loads (2-4N).

2.1. Materials
Polycotton knit fabrics were washed in a washing machine with one detergent (either powder or liquid) and different rinsing conditions (clear rinse (no rinse-added softener), varying dosages of 2 softening formulations).

2.2. Results
Values of Coefficient of Friction (COF) and root mean square of the acoustic signal (RMS) were calculated for each dataset. The median and the top 5% percentile were extracted respectively for the dynamic and static regions, for each sliding movement, in order to perform an analysis of variance and identify statistically significant parameters amongst those studied (normal load applied, velocity, detergent and softener used).

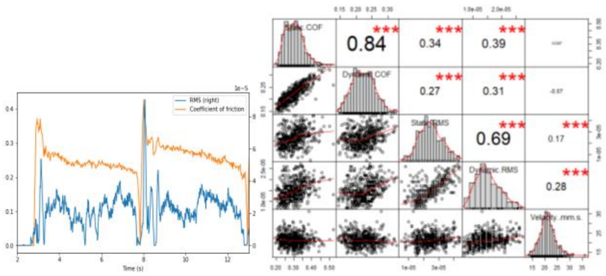

Figure 1: *(left)* RMS of the AE signal and COF measured for a human finger in reciprocal sliding movement on a polycotton knit fabric (liquid detergent, clear rinse, 2N applied), *(right)* Correlation Matrix for the extracted RMS, COF and velocity.

3. Discussion

A good correlation is found between the RMS of the acoustic signal acquired and the COF measured upon the friction of human skin in contact with treated fabrics. A highly statistically significant Pearson Coefficient (~0.30) was established between COF and RMS, both in static or dynamic conditions.
The analysis shows that the use of softener treatments reduces both the COF and RMS of the acoustic signals. Indeed, a fabric perceived as softer by the consumers has a lower skin-fabric friction, both in terms of static and dynamic COF, as well as a lower energy emitted as an acoustic wave. The method allows to differentiate fabric treatments, which has been challenging for conventional tribological rigs.
The work demonstrates the suitability of Acoustic Emission in evaluating tribological phenomena on soft materials such as fabrics, which offers a practical and powerful new method for evaluating tactile friction that underpins sensorial benefits.

4. References

[1] Schindler W.D. et al., "3 - Softening finishes", Chemical finishing of textiles, Woodhead Publishing Series in Textiles, 2004, 29-42.