ANALYSING OF DRAPING PROPERTIES OF TEXTILES

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Abstract: *The aim of work is to analysing the draping properties of fabrics and to find relations for the simulation of textile material behavior among the raw material, structure, production technology, measurable properties and drape properties of fabrics. The contribution reveals the relations between parameters that influence material behaviour and the drape behaviour and the comparison of different measuring methods*

Key words: Drape ability, drape coefficient

1. INTRODUCTION

Drape ability is a three-dimensional phenomenon, caused by the force of gravity on textile fabric. The fabric hangs because of its own mass that causes large displacements and small tensional, shearing and bending deformations, which is shown in a form of resulting folds. Relationship between projection of deformed form (area of draping shadow) and un-deformed fabrics is defined as drape coefficient. The high value of drape coefficient means that the fabric is stiff and therefore it could be difficult to re-form. Alternatively, low value of drape coefficient means easier reform and at the same time, better adaptation of fabric to the shape of cloth (Geršak, J., 2003).

2. EXPERIMENTS

In order to be able to separate the impacts of material characteristics that influence drape behaviour samples were tailored to especially these investigations. We have investigated 16 woven samples to explore relationship between parameters that influence material behaviour and the drape behaviour furthermore the comparison of different measuring methods.

2.1 Fabrics used

The samples were *Cotton fabrics with different structural characteristics but prepared with the same finishing technology,* Table 1. When the setting versions were determined, 2 to 4 significant values were assigned to each parameter. Finishing after weaving only involved desizing.

Table 1: Characteristics of the fabrics

Samples number	Changed parameters *	Value of changed parameter
1.	Warp yarn tension	40cN/yarn
2.	Warp tension	30 cN/yarn
3.	Warp tension	50 cN/yarn
4.	pattern	Twill $K\frac{2.}{.1}Z$ $K\frac{.1.}{1.1}S$
5.	pattern	Twill $K\frac{3.}{.2}Z$
6.	pattern	panama $P\frac{3.}{.3}$
7.	pattern	weft rep $Pw\frac{3.}{.3}$
8.	pattern	Atlas (6-yarn)
9.	Raw material of weft yarn	67% viskose/33% linen
10.	Raw material of weft yarn	50% polyesther/50% cotton
11.	Raw material of weft yarn	100% PES
12.	Weft yarn finenss	29.4 tex
13.	Weft yarn fineness	16.6 tex
14.	Weft yarn fineness	10 tex
15.	Weft yarn density	160 yarn/10cm
16.	Weft yarn density	120 yarn/10 cm

*Basic setting: 90 g/m^2, Plain weave, 100 % cotton, warp yarn fineness 25 tex, yarn density: 42/20 yarn cm$^-$

2.2 Methods

The samples described in Table 1 were studied more thoroughly and with a wider range of investigations. Several measurements were carried out in the Laboratory for Clothing Engineering, University of Maribor. The rest of the measurements were carried out in the laboratory of Department of Textile Technology, Budapest Polytechnic and in the Laboratory of Department of Polymer Engineering, Budapest University of Technology and Economics. The following mechanical characteristics were investigated: strength and strain properties in different directions in case of tensile, shear, bending and compression tests; surface properties of fabrics using the KES FB AUTO system. Following drape testing methods was used, Fig. 1:

- drape behavior with Cusik drape tester (using Drape Analyser programme packages).
- drape behavior with weight measurement
- drape behavior with image-based cloth capture and cloth simulation ,

	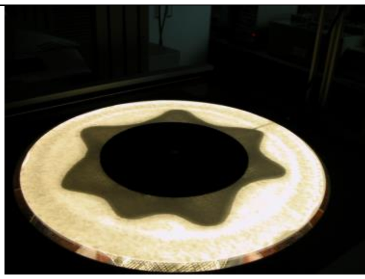
Drape Coefficient calculeted by measurement of the weight of shadowed and non-shadowed area of the paper ring. $DC = \frac{M_2}{M_1} \cdot 100\%$ M_2 : Mass of shaded area M_1 : Mass of paper ring	**Drape Coefficient calculeted by Fourier Analyses:** $A = \int_0^{2\pi} \int_0^{f(\varphi)} r\, dr\, d\varphi$ $= \int_0^{2\pi} \frac{1}{2} f^2(\varphi)\, d\varphi$ $= \frac{a_0^2}{4}\pi + \sum_{k=1}^{\frac{n}{2}-1} (a_k^2 + b_k^2)\frac{\pi}{2} + \frac{a_{n/2}^2}{8}\pi$

Figure 1: Different calculation methods of Drape Coefficient

3. RESULTS AND DISCUSSION

On the basis of the research the achieved results can be presented in the following form:

- the impact of fabric structure on the mechanical properties of fabrics and their drape behaviour,
- comparison of different measuring methods of drape coefficient.

3.1 The impact of fabric structure on the mechanical properties of fabrics and their drape behaviour

The analysis of the impact of fabric structure on mechanical properties of the fabrics indicates that individual parameters of fabric structure as well as weaving parameters directly impact mechanical properties. Further the analysis of the results obtained for the relationship between parameters of fabric structure and drape behavior of fabric shows that parameters as are weaving coefficient, yarn density and fineness of weft yarn are directly associated with drape behaviour of fabric. It is useful to investigate the drape coefficient in accordance to the cover factor, or weaving coefficient X. Analysis of the results shows a tendency of drape coefficient DC to grow with growing values of weaving coefficient, Fig. 2.

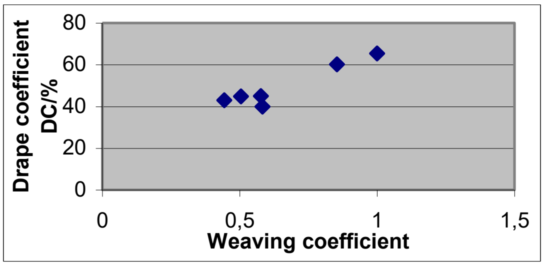

Figure 2: Influence of weaving coefficient of the fabrics with different pattern on drape coefficient DC

The tendency of drape coefficient DC :

$$DC = b_0 + b_1 * X ,$$

where DC is drape coefficient [%] and X is weaving coefficient, the obtained partial correlation coefficient by linear regression analysis: R=0.9455, b_0=19.734; b_1=45.423. The drape coefficient of plain weave fabrics or panama weave fabrics, which it is traced back to plain weave fabric, are greater because of the many, tight cross points than the twill fabrics produced from the same yarn. Furthermore it can be stated that increasing the yarn density as well as yarn fineness the bending rigidity and drape coefficient associated with it generally increases (L. Kokas Palicska, Geršak, J. M. Halász (2005)). The drape properties are influenced by several factors such as weight per unit area [g/m^2], pattern, composition of the fabric, production technology, finishing etc.

3.2 The comparison of different measuring methods of drape coefficient

The values of Drape Coefficient calculated by Drape Analyser program and by measuring of weight indicate that the kind of measuring methods influences the results by 20-35 %, Figure 3. These results were measured on finished samples (100%) viscose (L.Kokas Palicska, J. Geršak, M. Halasz, 2005).

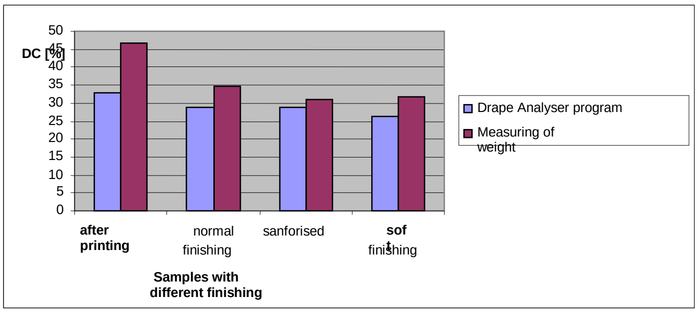

Figure 3. Drape coefficient of finished fabrics measured with different methods

The analysis of the results obtained for the relationship between measuring of drape coefficient by image based cloth capture and the Drape Analyser program shows that there is not too much difference between the two methods (Fig.4). The sample number 11 was not included in the measuring. The captured contour and the recovered fabric model are shown on Fig. 5.

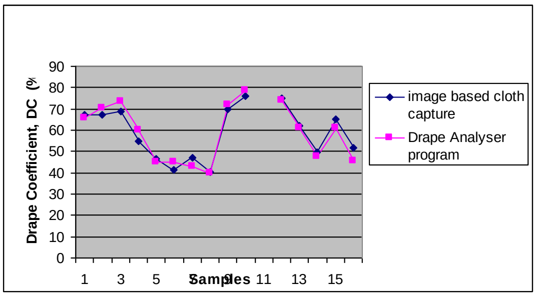

Figure 4:. Drape coefficient mesured with image based capture and Drape Analyser program

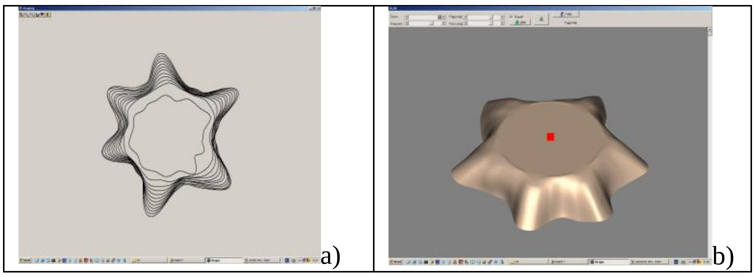

Figure 5: Captured contour after Fourier transformation (a) and recovered model (b)

4. SUMMARY

The analyses of results of research of the impact of fabric structure on the drape behavior of fabrics have shown a significant correlation. Our wide range investigations support that the drape behavior is the most complex properties of the fabrics. We have tried to compare different methods for measuring drape properties. We have obtained data to set up a relationship between the measured physical properties and the drape properties. These results have been using to develop a computing model that simulates the spatial mechanical behavior of fabrics in the preparation for production of models in the apparel industry (J. Kuzmina, P. Tamás, M. Halász, (2005), Tamás, P., Halász, M., Gräff, J. (2005)).

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