FABRIC DRAPE EXAMINATION USING RING-CONTROLLED EQUIPMENT

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ABSTRACT

Drape testing has been one of the main methods to determine 3D textile properties as the obtained test results can be used in textile draping simulations. In drape tests, the effects of material, structure and finishing of textiles as well as the mechanical properties of fabrics have been studied extensively, although the deviation of the measured parameters and the reasons behind such deviations have always caused problems. Researchers also studied drapability under dynamic effects and measured dynamic drape by rotating textile samples. It was found that drapability can change significantly due to the dynamic effects and the change in strain can have different impacts on different textile materials. On the other hand, tests cannot always reveal reproducible results since the dynamic effect is not always uniform.

In this study an apparatus was mounted on the Sylvie 3D Drape Tester, which uses a 3 dimensional scanning technology and records surface data of draped textiles to obtain a well defined dynamic effect on textiles during draping. Using this ring-controlled instrument, the reproducibility of test results and possibilities of dynamically influenced measurements were investigated. The tests were carried out on 100% cotton plain woven fabrics with different parameters.

Key Words: Fabric drape, drape testing, dynamic drape

1. INTRODUCTION

Drape measuring systems are popular to determine 3D properties of textiles as the measured results can be used for the simulation of the drapability of textiles. However, there is a problem with high deviation in measured parameters as the reason behind it is not known well. As many earlier study indicated, the material, structure and finishing method of the fabric, as well as mechanical effect of the examination are all influencing factors for drapability test results [1]. Researchers also studied drapability under dynamic effects and measured dynamic drape while the textile samples were rotated. It was found that drapability can change significantly due to dynamic effects and the change in strain can have different impacts on different textile materials. On the other hand, tests cannot always reveal reproducible results since the dynamic effect is not always uniform.

Apart from static drape, the measurement of drape in dynamic state has gaining importance in terms of real-wear simulations. One of the first studies on dynamic drape has been carried out by Stylos and Zhu [2] as they developed a system called M3 which can deal both static and dynamic measurement. The dynamic measurement was realized by rotating the sample supporting disc. Later Yang and Matsudaira [3] introduced a new parameter named as revolutionary drape, D_r, where a fabric sample is turned around at a speed of 200 rev/min. Same researchers introduced another parameter for dynamic state, D_d, which indicates drape of fabric in a pendulum type of movement and such a drape was reported as a better simulation of human body in movement [4]. Similarly, Shry et al. [5] also indicated that static drape is not enough to forecast dynamic movements and measured dynamic drape of fabrics at a speed of 100rev/min and 125 rev/min.

The Sylvie 3D Drape Tester developed at BME [6], different from the popular Cusick Drape Meter, records all surface data of draped textiles with a 3 dimensional scanning technology, and the evaluating computer system defines the usual drapability data, i.e. node number and drape coefficient.

According to the literature we suppose that the drapability of textiles will differ at different levels of stress. The Sylvie 3D Drape Tester was supplemented with a tool with the help of which drapability could be determined after different but exactly defined dynamic effects [7]. This apparatus is a ring shaped plate which can have different diameters. Using this ring-controlled instrument the reproducibility of test results and possibilities of dynamic measurements were investigated. The tests were carried out on 100% cotton plain woven fabrics with different parameters.

2. MEASURING SYSTEM

The table of the Sylvie 3D Drape Tester (Figure 1) at the initial state is in the same level with the base plate. The table has a diameter of 180 mm. The diameter of the fabric sample is 300 mm. During the tests, the centre of the sample has to be set exactly on the centre of the table, and warp and weft directions have to be parallel with the specified directions. A computer controlled motor lifts the table, assuring that drapability is always studied at the same speed and under the same dynamic effects. During the measurements, four laser emitters project laser lines on the fabric sample in order to determine the cross-section and four cameras record the lines over the laser emitters. The cameras and the laser emitters are mounted on a measuring frame. The frame moves with a determined step distance during scanning the surface of the fabric sample. The computer controlled instrument is constructed in a black box in order to provide darkness during the measurement. After all photographs are taken, the computer downloads the pictures [6].

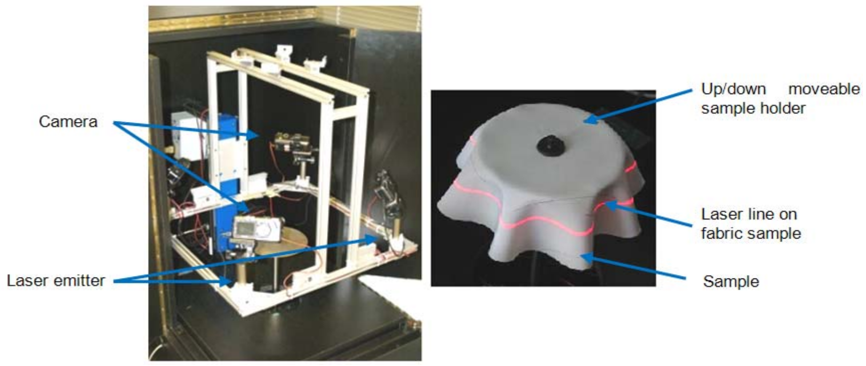


Figure 1 Sylvie 3D Drape Tester

To examine the dynamic effect on the fabric sample, the instrument was completed with a special tool having different dimensions. The tool is a ring with different internal diameters. The external diameter of both rings is 350 mm, and the internal diameter of the first one is 240 mm, while that of the other one is 210 mm (Figure 2).

For the sake of simplicity, the ring that has 240 mm inner diameter will be referred to as the 240 mm ring hereinafter, whiles the ring that has 210 mm inner diameter as the 210 mm diameter ring.

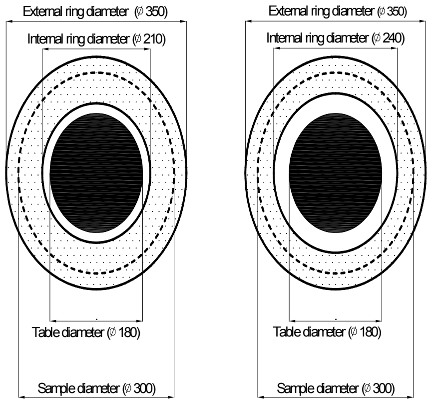


Figure 2 Dimensions of rings

When the table moves up, the fabric sample is drawn through the inner hole of rings (Figure 3). During this process, the fabric is subjected to a dynamic effect. We suppose that the ring with smaller internal diameter has larger dynamic effect on the drapability of the fabric [7].

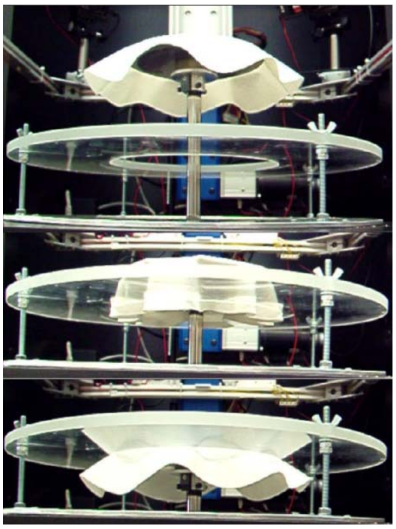


Figure 3 Drape tester completed with rings

3. MEASURING RING CONTROLLED DRAPABILITY OF TEXTILES

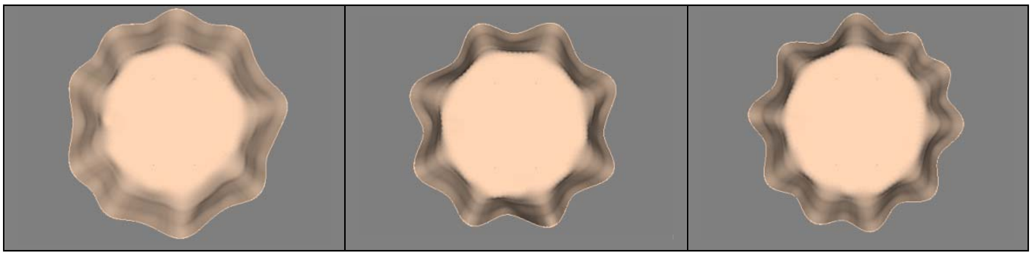
Three cotton samples were examined with the Sylvie 3D Drape Tester completed with rings. The fabric samples differ in the twist direction of the yarns they are composed of. Detailed properties can be found in Table 1 below.

Table 1 Main properties of the examined textile samples

No.	Material	Type		Density [g/m^2]	Type of weave	Yarn count		Yarn density [1/10mm]		Twist direction	
		warp	weft			warp	weft	warp	weft	warp	weft
P1	cotton	OE-rotor	OE-rotor	158.6	plain	Nm 34	Nm 34	26	22	Z	Z
K2	cotton	OE-rotor	OE-rotor	148.6	plain	Nm 34	Nm 34	26	22	Z	S
F3	cotton	OE-rotor	OE-rotor	156.2	plain	Nm 34	Nm 34	27	22	Z	Z+S

Three samples of all the three fabrics were measured (alternately with their top and reverse side) 10 times without the ring, and 10 times with the two rings. In both cases, the same relaxation intervals were kept between the measurements.

Different dynamic stress situations are modeled with rings with different inner diameters. When the table moves up, the test materials are drawn through the inner hole of the rings. If the measurement is carried out without any ring, the draping process can be considered as quasi static. Measuring with different rings simulates the process of throwing the material on a table at different speeds and that is closer to a real wearing situation.



a) b) c)

Figure 4 Measuring with different rings

a) No ring, b) Ring D240, c) Ring D210

When rings are used, draping ratio and wavelength of the edge curve of the material decreases, the number of waves increases and draping geometry shape is more moderate. The smaller the inner radius is, the more influence it has. Figure 4 shows the different resulting simulations.

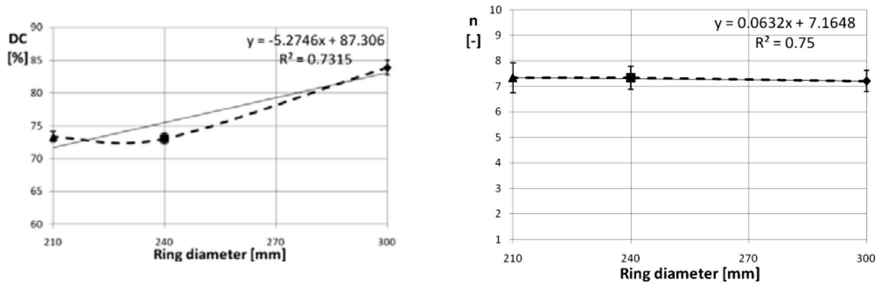
4. TEST RESULTS AND DISCUSSIONS

Altogether 30 measurement results were obtained during the measurements for all the examined fabric samples in both static and dynamic mode and the test results are summarized in Table 2. In order to be able to handle all results in a uniform way, the measurement carried out without a ring was considered to be a test with a ring that has an inner diameter of 300 mm, which is exactly the diameter of the fabric sample. In this case, obviously the ring could not have affected the measurement, since it could not even touch the sample. However, this way all the results can be graphed and evaluated in common diagrams as a function the ring diameter. Figure 5 illustrates the average values and the deviations of the drape coefficients and node numbers as a function of the ring diameter.

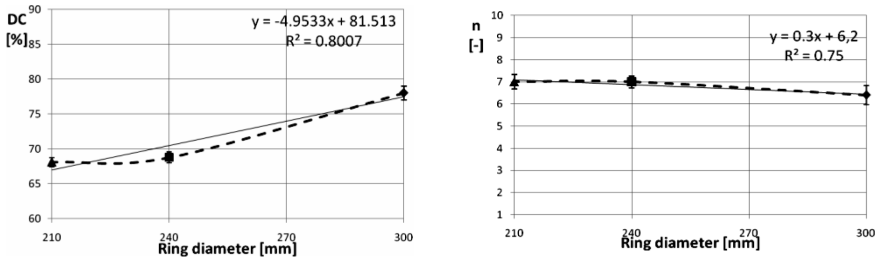
Table 2 Test Results showing mean drape coefficient values and deviations

Ring diameter	**300 mm**		**240 mm**		**210 mm**	
P1						
	DC	**n**	**DC**	**n**	**DC**	**n**
	[%]	**[-]**	**[%]**	**[-]**	**[%]**	**[-]**
Mean	83.88	7.21	73.07	7.33	73.33	7.33
Deviation	2.29	0.82	1.63	0.90	1.63	1.18
K2						
	DC	**n**	**DC**	**n**	**DC**	**n**
	[%]	**[-]**	**[%]**	**[-]**	**[%]**	**[-]**
Mean	77.99	6.40	68.75	7.00	68.08	7.00
Deviation	1.99	0.86	1.55	0.53	1.30	0.65
F3						
	DC	**n**	**DC**	**n**	**DC**	**n**
	[%]	**[-]**	**[%]**	**[-]**	**[%]**	**[-]**
Mean	81.36	7.00	71.69	6.60	71.99	7.00
Deviation	3.73	0.87	1.80	0.74	1.06	0.53

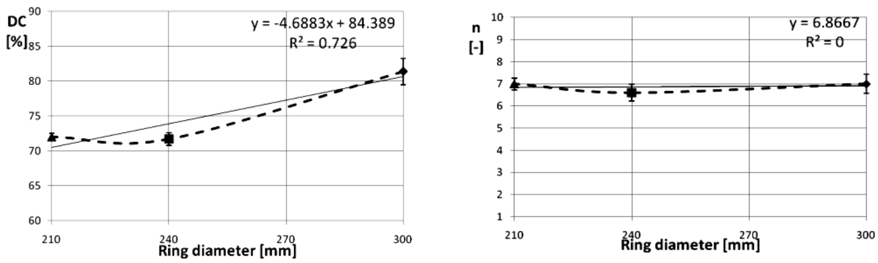
The test results show that drape coefficient changes similarly in case of all three materials as a function of the ring diameter. It can be observed that the drape coefficients measured with a 240 mm ring decreased by more than 10% compared to the measurements carried out without a ring (300 mm diameter ring) in case of all the three materials, and simultaneously the deviation of the drape coefficient also decreased significantly.



a) Drape coefficient and node number of material P1



b) Drape coefficient and node number of material K2



c) Drape coefficient and node number of material F3

Figure 5 Drape coefficients (DC) and node numbers (n) of three different materials (P1, K2, F3) with no ring (300 mm ring diameter) and with two different rings (240 and 210 mm diameter)

It can also be observed that in case of measurements carried out with a 210 mm ring, the mean drape coefficient does not differ significantly compare to 240 mm ring, however deviation decreased undoubtedly. The much lower deviation of the values measured with rings proves our assumption that the reproducibility of measurements improve as the ring diameter decreases. On the other hand, these results reveal that the node numbers do not change unambiguously, hence surprisingly node number does not seem to be applicable for the exact description of textile drape behavior.

5. CONCLUSION

Drapability is most often characterized with the drape coefficient and node number. Based on the measurements of the examined cotton fabrics with and without rings, it can be stated that the drape coefficient is much more capable of highlighting the difference in draping between different measurement methods and material types compare to the node number.

The test results also revealed well that rings have a significant impact on the draping. The results also show that both the drape coefficient and its deviation decreased significantly as the ring diameter became smaller.

In addition to the rings used in this work, we are planning to carry out measurements with a 270 mm diameter ring that is missing from the series, so that the dependence of the measured properties on the ring diameter can be evaluated at evenly distributed values within the possible range (i.e.180 – 300 mm).

According to our opinion, if draping behavior characterization of textiles is the aim, measurements with rings can give more reproducible results and might be considered as a more suitable approach for the conditions of real garment wearing compare to the measurements without rings.

6. ACKNOWLEDGEMENT

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