Effect of the reinforcement agents (starch spray) on the appearance properties of outwear clothes

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Abstract:
Influence of the reinforcement agents like starch spray on the appearance properties (drapeability and bending stiffness) has been investigated in this study. Two different blended fabrics are been chosen for the experiments. Four cases are been tested for every fabric (row, first time starch, after washing and second time starch). Results confirmed the significant effect of the starch spray on the changing the drape coefficient of the tested fabric, beside that the folds shape and number are also influenced. The starch spray also affected the bending length and weight per unit area obviously. The four fabric cases confirmed that the use of starch sprayer increases the stiffness and the drape coefficient of the material even if the material was washed after each use.

Keywords:
Bending stiffness,
Drape coefficient,
Drape folds,
Starch spray

Paper received 15th April 2018, Accepted 12th June 2018, Published 1st of July 2018

1. Introduction
Satisfying appearance and good draping should be used to classify garments production quality. These properties depend on not only on the kind of raw material applied and on the structure of fabrics, but also on the kind of finishing. For that reason, a suitable selection of the kind of finishing agents, which would alert creation of the fabric properties, plays an important role in clothing design [12].
Garment textiles may contain a number of chemical substances. The dyes, auxiliaries and finishing agents ensure colour fastness during washing, a stable shape or a wrinkle-free garment. Reinforcement agents can be used to modify fabric hand and change draping quality. Starching gives body, weight, smoothness and stiffness to fabric.
Starch spray is a formula that revives fabrics, making them look new, crisp and wrinkle-free. Helps keep clothes cleaner, longer and to wash clean more easily. Also helps to control static cling. Starch works on shirts, skirts, pants, dresses and more. It is ideal for finer, everyday fabrics that need a gentle starching. Starch provides an easy-glide surface on fabrics to make ironing quicker and easier and then sets the fabric to hold the results so you don't need to repeatedly iron over the same surface to achieve the crisp, professional results you want to achieve [17].

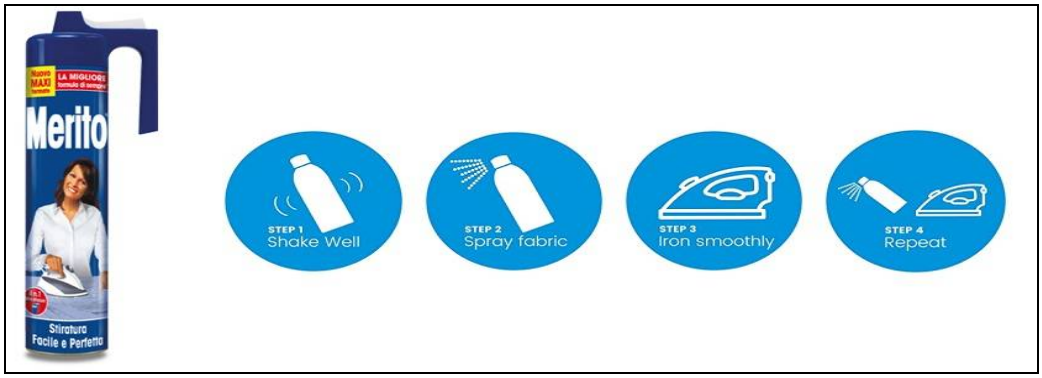


Figure 1: Starch sprayer and using steps [8], [9]

In figure 1 the starch sprayed and the steps of applying the starch spray are represented as follow:

1- Shake starch spray for clothes vigorously for 5 to 10 seconds
2- Hold the can 6 to 10 inches away from your clothes or sheets at a 45 degree angle and press down
3- Set your iron to the correct fabric setting before proceeding

4- Repeat the spray and iron steps until you achieve the level of firmness you want [9], [10].

Garment quality is not only defined through its aesthetic and functional properties, but also as mechanical and physiological of wear, e.g. the feeling of well being in wearing, its proper drape and fit – visual quality of form [13].

There are many examples of bad shapes stability in textiles after washing, especially in the case of woven fabrics made of blended fibers (CO/PES).

The drape and the bending stiffness of woven fabrics are the two essential properties in the judgment of the garment appearance.

Fabric drapeability:

Fabric drape is a very essential low stress mechanical property that determines many of the sensible qualities of clothing. When fabric is draped, certain parts of it form curves in more than one direction. This property helps a fabric to be molded into pleasing shape or to produce a smooth flowing form by its own weight [3].

It is a complex combination of a fabric's physical, mechanical and visual properties which can be evaluated either subjectively or objectively [15].

There have been numerous instruments, ranging from a simple cantilever bending tester to a dynamic drape tester developed for measuring fabric drape (The Drape meter). Drape co efficient (DC) the main parameter used to quantify fabric drape [14].

The drape behaviour is the draping experiment (Figure 2) carried out using the drape meter developed by Cusick [4] and the calculation of the resulting drape coefficient DC in percent.

The drape image is characterized by the area, the form and amplitude of the folding, the number of folding and their position with regard to warp and weft direction.

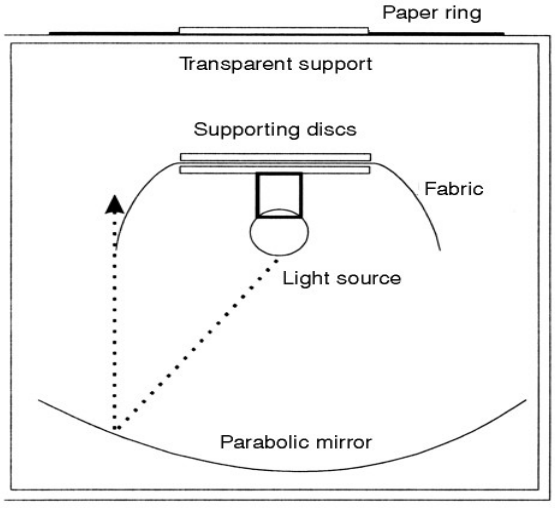


Figure 2: Principle of Cusick drape meter tester [4],[6]

The Drape coefficient is confined in the range 0 – 100 percent. Very stiff fabrics have a drape coefficient close to 100 percent, whereas soft fabrics have a DC close to 0 percent. Values of drape coefficients ranged from 30 percent for fabrics of loose open weave rayon fabric for a starched cotton gingham, and about 95% for stiff nonwovens [6] [7].

Fabrics are classified on the basis of the drape coefficient. A high drape coefficient indicates a small deformation whereas a small drape coefficient marks great deformations and more waves [8].

Bending stiffness:

The bending length is a measure of the interaction between fabric weight and fabric stiffness in which a fabric bends under its own weight. It reflects the stiffness of a fabric when bent in one plane under the force of gravity and is one component of drape. Thus bending length is also called drape stiffness. The bending length is dependent on the weight of the fabric and is therefore an important component of the drape of a fabric when it is hanging under its own weight. The stiffness of a fabric in bending is very dependent on its thickness. The thicker the fabric, the stiffer it is, if all other factors remain the same. The bending modulus is independent of the dimensions of the strip tested, so that by analogy with solid materials it is a measure of 'intrinsic stiffness' [11].

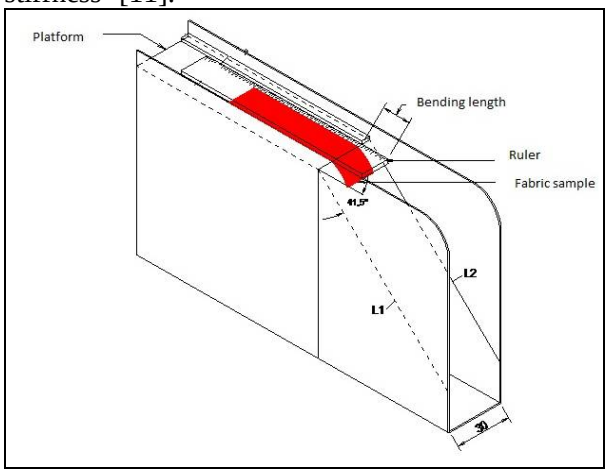


Figure 3: bending stiffness acco rding to Cantilever method [16]

The bending length is measured based on a cantilever principle. For the Cantilever test, the Shirley Stiffness tester or the Gurley Stiffness tester is commonly used. The tester is based on the cantilever principle (figure 3) . In the test a rectangular strip (25 mm wide × 200 mm long) supported on a horizontal platform is clamped at one end and the rest of the strip is allowed to overhang and bend under its own weight as shown in figure 4 [4].

Study problem:
Excessive use of starch sprays during ironing to facilitate ironing has a significant effect on changing the appearance properties of clothing such as stiffness and drapeability, which leads to stiff of the clothes, bad appearance and fabric defects

Scope of the study:
This study aims to determine the effect of the starch sprayer, which commonly used by ironing, on changing the appearance properties of the outwear clothes, in terms of the bending stiffness and the drape of the fabric.

2. Materials and Methods

In this study there are two lightweight with plain weave fabrics are used. The classifications of the tested materials are been presented in table 1.

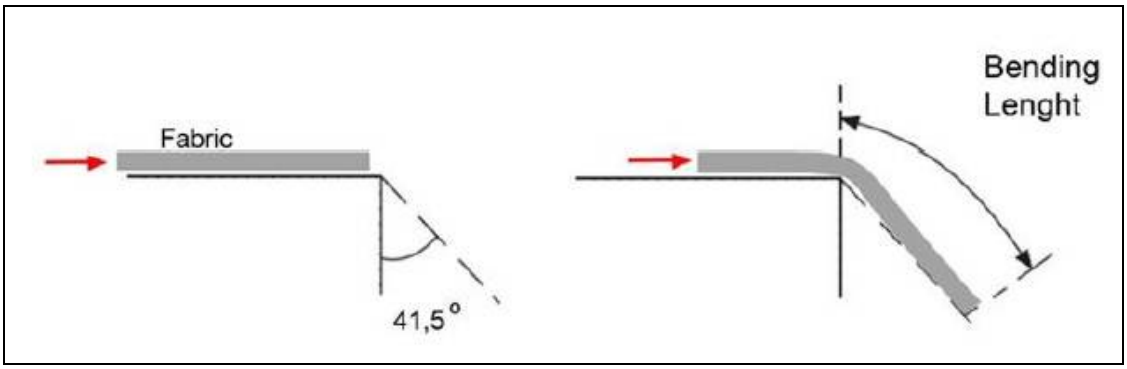
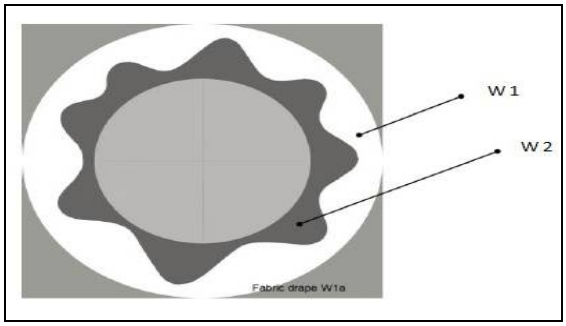


Figure 4: Bending length determination [1]

Table 1: Investigated fabrics

Fabric Code	Fabric contents	Weave structure	Weight per unit area [g/m^2]	Thickness [mm]	Fabric density/cm	
					Warps/cm	Picks/cm
F1	50% CO, 50% PES	Plain 1/1	82.5	0.30	38.9	28
F2	50% CO, 50% PES	Plain 1/1	88.5	0.34	37.8	28

(a): photograph of the device



(b): Paper ring and draped shadow

Figure 5: Drape experiment

The two fabric were sprayed with starch sprayer (MERITO - SPRAY), which classified as an ironing aid. Four cases (row material, first time starch, after washing and second time starch), were tested by every fabric.

Bending stiffness test is carried out with shirley stiffness device according to the Cantilever method and the bending stiffness is calculated according to ASTM-1388 [5].

The drape coefficient is calculated with the cut and weighs method. Figure 5 represents the Drape tester device and the paper ring and draped shadow resulted from the test.

The fabric drape is tested by using the Cuisick Drape tester and the DC was calculated according the following formula [3].

$$DC = \frac{W2}{W1} \times 100$$

Where DC: The drape coefficient
W1: Weight of the ring paper in
W2: Weight of the shadow of the drape in g [4].

1- Results and Discussion

To determine the effect of starch spray on changing the behavior of the appearance properties, such as bending stiffness and drapeability, the tested fabric were tested in four cases: row material, first time starch, after washing and second time starch.

Influence of the starch spray on the bending stiffness

It is obviously in table 2 that, the starch has a significant effect on the bending stiffness of the

fabric.

Table 2: Results of the bending stiffness

Fabric case	Bending Stiffness [mN.cm]	
	Fabric 1	Fabric 2
Row material	1.71	0.57
First time starch	2.38	1.91
After washing	1.25	0.79
Second time starch	3.59	3.22

Figure 6 showed the four cases of the fabric, which confirmed the continuous effect of starch spray on increasing the hardness of the cloth. The correlation factors and regression equations for the two materials are calculated. The polynomial correlation from the third degree was applied and the Correlation factors resulted were (1), which confirms the tied relation between the using numbers of the starch on the hardness of the cloth.

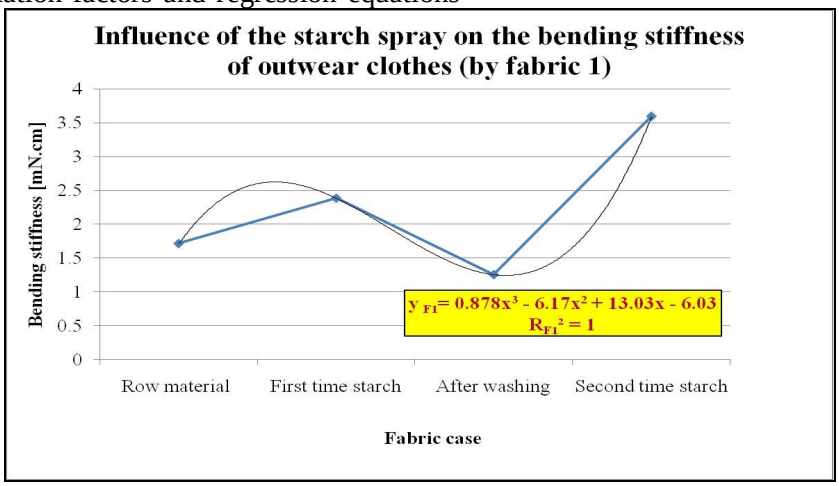
The regression equations and correlation factor are represented as follow:

$y_{F1} = 0.878x^3 - 6.17x^2 + 13.03x - 6.03$ (Regression equation (Stiffness) for Fabric 1)

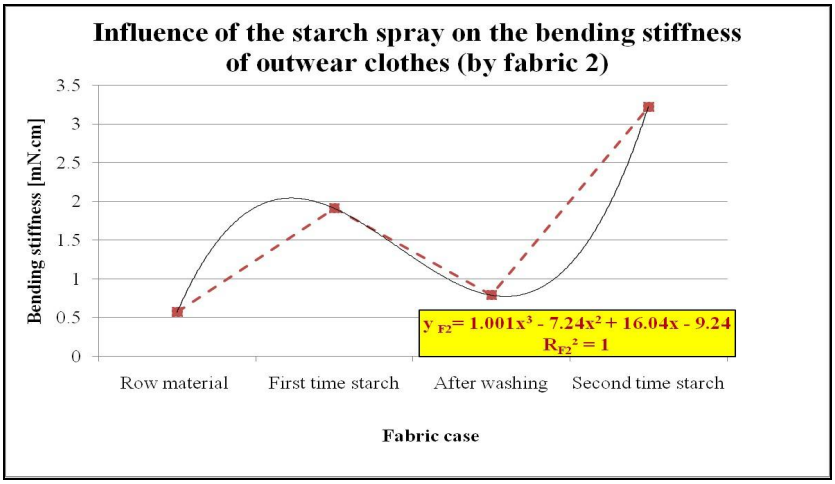
$R_{F1}^2 = 1$

$y_{F2} = 1.001x^3 - 7.24x^2 + 16.04x - 9.24$ (Regression equation (Stiffness) for Fabric 2)

$R_{F2}^2 = 1$



(a): Fabric 1



(b): Fabric 2

Figure 6: Influence of the starch spray on the bending stiffness

Influence of the starch spray on the drapeability

The drape coefficients are strongly affected by using the starch spray as shown in table 3.

Table 3: Drape coefficients of the fabrics

Fabric case	Drape coefficient (DC) [%]	
	Fabric 1	Fabric 2
Row material	67.75	38.28
First time strach	76.57	69.61
After washing	55.92	64.04
Second time strach	81.90	88.63

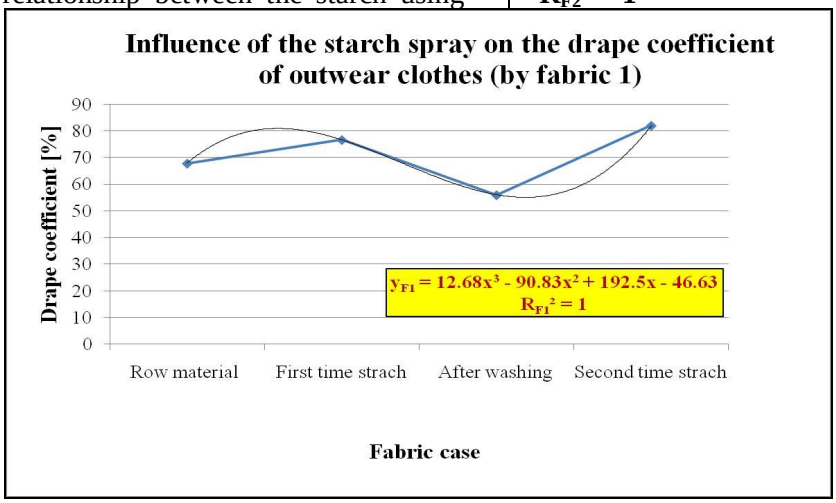
The higher the use of starch sprays, the greater the drape coefficient of fabric and thus increase the hardness of the cloth.
The polynomial correlation from the third degree was applied and the correlation factors resulted were (1) by fabric 1 and fabric 2, which mean a very tied relationship between the starch using numbers and the drape coefficient (figure 7) .

$y_{F1} = 12.68x^3 - 90.83x^2 + 192.5x - 46.63$ (Regression equation (DC) for fabric 1)

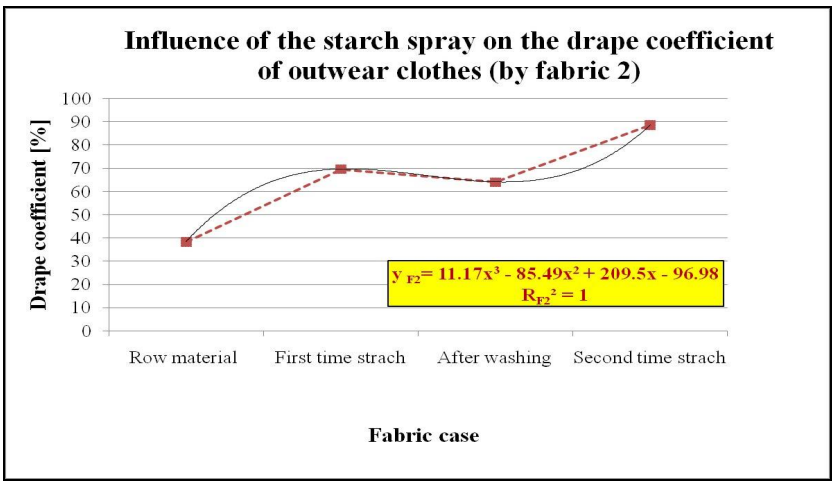
$R_{F1}^2 = 1$

$y_{F2} = 11.17x^3 - 85.49x^2 + 209.5x - 96.98$ (Regression equation (DC) for fabric 2)

$R_{F2}^2 = 1$



(a): Fabric 1



(b): Fabric 2

Figure 7: Influence of the starch spray on the drape coefficient

Figure 8 and 9 showed the drape folds of the four cases, which confirmed the compatible the results of the drape coefficient.

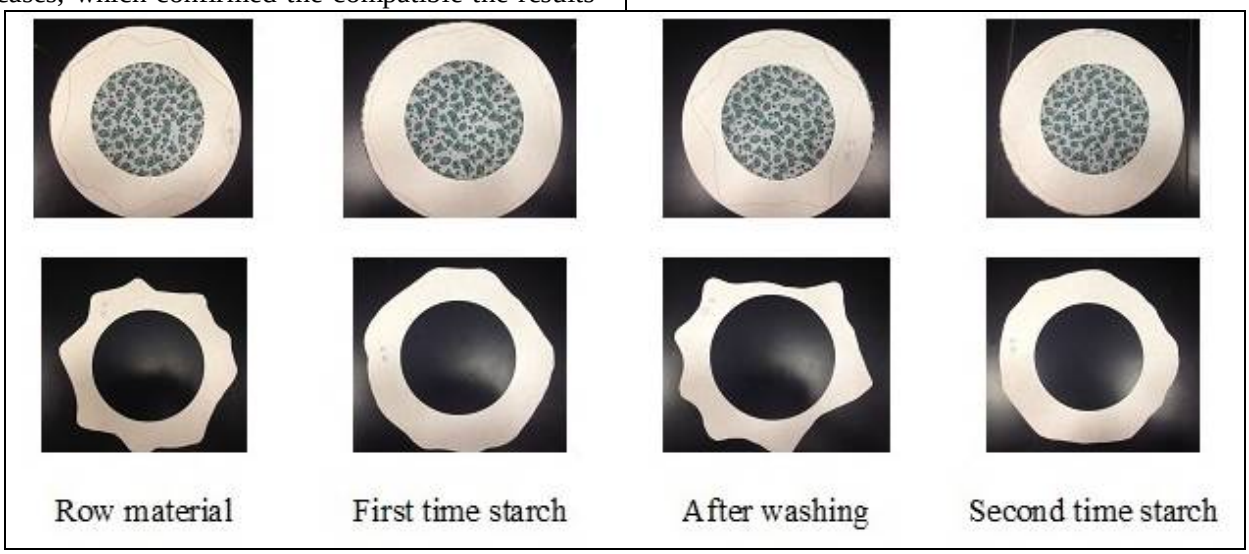


Figure 8: Drape folds of fabric 1 by the investigated four cases

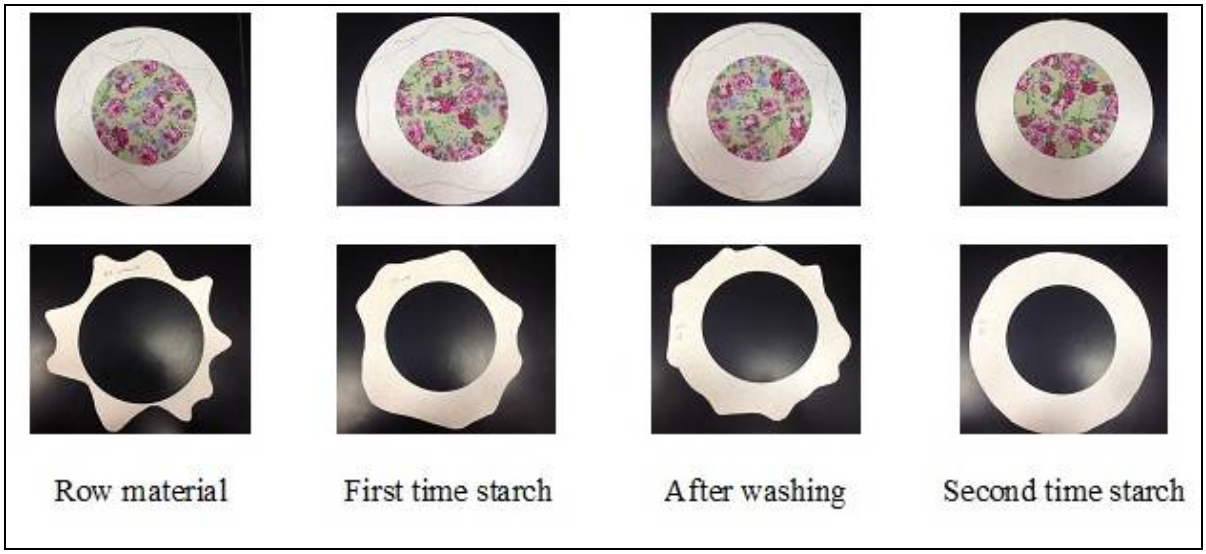


Figure 9: Drape folds of fabric 2 by the investigated four cases

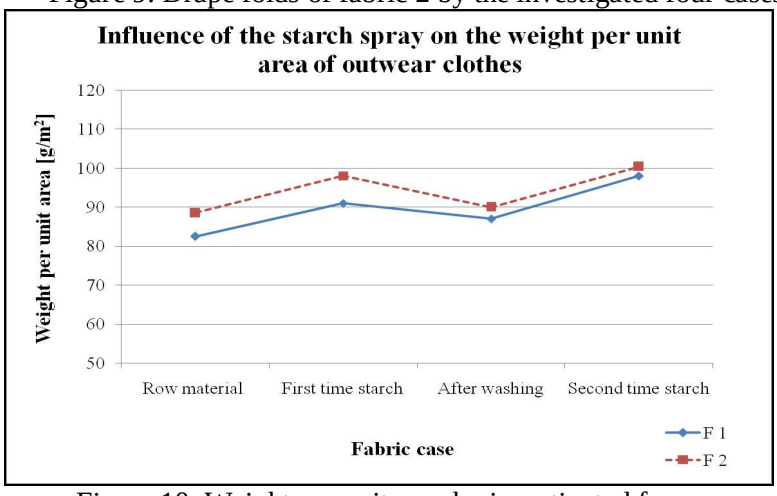


Figure 10: Weight per unit area by investigated four cases

The folds shapes changed according to the stiffness of the fabric resulted from the starch spray using. The area and the folds numbers of course changed also. It is obviously that the folds numbers by the row fabric and the case (after washing) are greater than by using the starch for first and second times.

The changes in the bending length and the drape coefficient maybe happened according to the change in the weight per unit area, since, since the use of starch spray leads to increase of the mass of the fabric. The weight per unit area was tested for every fabric by the four cases as shown in figure 10.

3. Conclusion:

In this study, the influence of the starch spray on changing the appearance properties of the outwear clothes, was investigated. Excessive use of starch sprays during ironing to facilitate ironing has a significant effect on changing the physiological properties of clothing such as stiffness and drapeability. The results confirmed that the starch has a significant effect in increasing the bending length, which leads to more stiffness in the cloth. For fabric caused the use of starch spray a higher drape coefficient, which mean more hardness of the cloth. The drape folds shapes were affected also by using the starch spray, since the folds disappeared according to the increase in the sample area. Each time the starch is used, increased the hardness of the cloth and reduced its drape, even if the clothes were washed, the effect will decreased by washing, but repeating the application of starch the effect of the starch spray appeared again strongly.

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