Methodology of designing women`s clothing with decoration from different fabrics

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Abstract

The article presents the results of the development of a methodology for designing women's clothing considering the properties of textile materials. Current collections of women's clothing models offered by leading Fashion houses in recent seasons were analyzed in order to clarify the classification of clothing decoration and the classification of three-dimensional decoration of clothes (ruffles, gatherings, puffs, draperies, etc.) is developed. Also, the physical and mechanical properties of samples of dress fabrics of various raw material composition and weaving are studied, in particular thickness, surface density, drapeability, and rigidity. Using the photogrammetric method, the quality of production of the knot with gathering for different gathering coefficients is evaluated and recommendations on the selection of the gathering coefficient for the knots of garments depending on the physical and mechanical properties of fabrics are provided. It is experimentally proved that thickness and bending rigidity of fabric influence the value of the gathering coefficient in the design of women`s clothing. Also, the recommendations on the selection of fabrics for the design of modern women`s dresses with decoration are provided.

Keywords: Gathering Coefficient, Physical and Mechanical Properties of the Fabric, Dress Fabric, Decoration of Clothing, Gathering, Drapery of the Fabric

Introduction

Design-projecting of clothes is a complex task that combines technological and artistic components. To produce aesthetic, competitive clothing, it is necessary to improve modern approaches to design-projecting of clothing, selection of materials, processing technology, and introduce innovations in the production process. The use of traditional and innovative types of decoration of clothing makes it possible to increase the aesthetic level and competitiveness of clothing, to diversify artistic and compositional solutions, as well as to enhance its artistic expressiveness.

Decorating and shaping details of the clothes with folds, gatherings, pinches, and other techniques are widely used in clothing design. In the season spring summer 2022/2023 the world`s Fashion Houses have presented many collections of clothes, in which new non-traditional design solutions are used, namely: a variety of embroidery, fabrics with perforations, applications, volantes, ruffles, gatherings, etc.

The use of different decoration in clothes of various assortment and purposes requires consideration of properties of textile materials, so the improvement of the process of design of modern clothing with three-dimensional decoration based on the study of the properties of fabrics is of current interest. In the article [1], the authors identify four main properties of fabric samples for the manufacture of clothing with three-dimensional decoration. The experiment of this study was to investigate the basic characteristics and physical properties of the fabrics and the behavioral correlations and changes during fold contraction and recovery process in order to produce the prototype.

Seymour S. [2] analyzes modern technologies in clothing design, identifies several directions for further development of innovative technologies, and singles out the direction of three-dimensional clothing design. In the article «The Fabrics Design Influence in Real and Simulated Drape of Clothing» [3] have studied the influence of properties of the fabric on fabric draping in the product both in real life and in virtual modeling using the Marvelous Designer program.

Balach M., Frydrych I., Cichocka A. in their work [4], the authors propose the method for modeling a virtual fabric drape on a virtual mannequin for different types of fabrics, considering their mechanical properties, which are measured using the KES system. Kiisel K. [5] and Hisako S. [6] have studied the decoration by draping fabric onto a dress form. In their works, a step-by-step creation and decoration of clothing using a three-dimensional decoration is considered.

Several studies are devoted to the peculiarities of technology and design of certain types of decoration. In particular, Yezhova O. at al. the article [7] provides recommendations on the technological parameters of decoration textile semi-finished products with machine embroidery.

The analysis of decoration of women`s clothing with decorative elements, including volantes, is presented in the article Pashkevich K. at al. [8]. The authors provide recommendations on the angle of cutting the volantes depending on the properties of fabrics of the costume group. Characteristics of the coat fabrics are studied Pashkevich K. at al. in the article [9]; the authors also provide recommendations on the selection of fabric with certain physical and mechanical properties to obtain a certain three-dimensional shape of the garment. Pashkevich K.L., Kolosnichenko M.V., Ostapenko N.V. [10] studies the properties of fabrics and determines the links between their physical and mechanical properties.

Sadeghi M. R., Jeddi Ali A. A. Shaikhzadeh N. S. in the research [11], the bending rigidity of twill and plain weavings is evaluated. Using two-component and three-component models, the relationship between bending rigidity, fabric structure, and rigidity of fibers used in weaving is identified. The authors state that bending rigidity depends on several factors, such as the geometry of weaving, rigidity, and density of the yarn. Sadoughi M., Boushehri A. N., Ezazshahabi N. [12] have studied three main properties of woolen fabrics, such as drapeability, bending rigidity, and shear strain; also, the relationships between them are identified. The authors have also found that drapeability is significantly affected by the weaving of the fabric, therefore, a correlation model for the prediction of drapeability is developed using linear regression analysis of the relationship between the coefficients of drapeability, indicators of rigidity, and shear strain.

Issues of decorating knitted fabrics with Ukrainian folk ornaments are considered Melnyk L., Kyzymchuk O., Zubkova L. in the article [13]. Goetzendorf-Grabowska B. at al. [14] comparatively evaluate three testing methods that utilise different measurement principles. The authors claim that the bending stiffness of a textile is a feature determining comprehensive indicators such as fabric drapability and handle. Most methods of assessing the bending stiffness of textiles are based on the principle of the determination of the strain and force dependence.

The conducted analysis has shown that many researchers are involved in improving the process of design, production, and artistic decoration of garments, which is related to the constant improvement of this segment of ready-made clothes. The emergence of new methods of decoration fabrics and products, the use of high-tech equipment, and the change in the direction of fashion, all require a study of peculiarities of the design of clothing with decoration based on the study of the properties of textile materials.

When designing women`s products, especially using three-dimensional clothing design technologies, it is necessary to solve the problems related to the difficulty of considering the properties of the materials in the formation of the shape of the product. In particular, this applies to products of complex shapes with draperies, gatherings, and folds, which are typical for women`s clothing. The fullness is usually calculated using the gathering coefficient, which indicates how much the length of the cut of the part of the garment, on which the gathering is performed, increases with regard to the original size of the part. And in the literature, the issues of dependence of gathering of knots of the garment on the properties of fabrics are investigated insufficiently, basically, there are some recommendations on setting the cap of the sleeve for various fabrics.

The purpose of the work is to study the features of designing women`s clothing with three-dimensional decoration considering the properties of fabrics, namely, to study the dependence of the size of gathering in the details of women`s clothing on the properties of fabrics.

Materials and methods

Materials

The work is complex multifaceted research based on a systematic approach and integrated application of general scientific methods of research and special methods of mathematical analysis. Considering the aim and the purposes of the research, it was decided to analyze 9 samples of dress fabrics (Table 1) of different fibrous compositions, which differ in their appearance (thickness, structure, type of weave, etc.). All examined samples of dress fabrics contain at least 15% polyester.

Table 1 : Characteristics of samples of the dress fabrics

Fabric sample	F1	F2	F3	F4	F5	F6	F7	F8	F9
Raw materials [%]	100 % polyester	80 % cotton / 15% polyester / 5% elastan	95 % polyester / 5 % elastan	97 % polyester/3% elastan	60 % polyester/40 % cotton	60 % polyester / 30 % viscose / 10 % cotton	80 % cotton/20 % polyester	100 % polyester	100 % polyester
Weave	Harness-satin	Harness-satin	Harness-satin	Harness-satin	Harness-satin	Plain	Plain	Plain	Twill

One of the main conditions for obtaining high-quality products is the correct and reasonable selection of materials considering the purpose and design features of the product, the methods used in the production, etc. When producing women`s clothing, especially dresses, blouses, etc., it is necessary to make a reasonable selection of fabrics to reproduce the idea and sketch of the design using the material.

Dress fabrics are characterized by a great variety of structural features, methods of basic and final processing. Their assortment is constantly changing due to the direction of fashion and innovations in the textile industry; producers use innovative fibers, change the structure of textile materials, and use different methods of processing. Dress fabrics are divided by raw material composition (natural, non-natural, synthetic, mixed), type of weave (plain weave, twill, satin, rep weave, fancy, etc.).

Methods

The focus was on determining the properties of the fabrics, such as: thickness, surface density, flexural rigidity and drapeability. The test was carried out in accordance with the current normative documents, kept up the requirements to the objects of the experimental research; the processing of the results of the measurements was made using the mathematical apparatus of statistical analysis of the data. The test was carried out in climatic conditions according to ISO standard 139:2005 [15]. Before the test, each sample had been kept in climatic conditions (relative air humidity 65 ± 4 % and temperature 20 ± 2 °C) for at least 24 hours.

Thickness is measured under the pressure of 1kPa according to ISO standard 5084-1996 [16]. The surface density of the fabric (mass per unit area, Ms) in g/m2 was determined according to (ISO standard 3801:1977) [17].

Drapeability, in accordance with (ISO standard 9073-9:2008 [18]), is “the ability of a circular specimen of a fabric of known size to deform when suspended under specified conditions”. The draperability of the materials is determined by the disk method using the special device. In evaluating the drapery properties of the dress materials of the different fibrous compositions, the recommended values of the drape coefficient of the dress fabrics, given in Table 2, were considered.

Table 2: Evaluation of the degree of drapeability of the dress fabrics according to [19]

Fibrous composition	Drape coefficient C_d, %		
	well	satisfactory	bad
Cotton	>65	45…65	<45
Wool	>80	68…80	<68
Silk	>85	75…85	<75

The rigidity is determined using the console non-contact method according to GOST (State Standard) 10550-93 [20], using a device of type PT-2. For the study, 5 elementary samples were cut in longitudinal and transverse directions with dimensions of 160 × 30 mm. In accordance with the recommendations [21], the coefficient of rigidity of the dress fabrics shall not exceed 4000 – 9000 μN·cm2. Methods for determining indicators: thickness, surface density, flexural rigidity and drapeability are given in scientific articles [7-9].

The tests are performed in accordance with current regulations in compliance with the requirements for the objects of experimental research, the processing of the results of experimental research is performed using the mathematical apparatus of statistical analysis of data. Statistical verification of the results of the study of samples of dress fabrics is performed and the absolute and relative accuracies in the processing of experimental data are determined.

To analyze the behavior of fabrics of dress group in a product depending on their properties, the models of knots of clothes with gatherings are made. The knot consists of a lower part 15 cm long, the upper edge of which is gathered and sewn to a strip of fabric 5x17 cm, which is duplicated. The gathering is formed using a sewing machine lockstitch, the stitch length is 3 mm. Two parallel stitches are made at 2 mm. For each of nine fabrics, three knots are made with gathering coefficients Cgath 1.4; 1.8 and 2.2.

During the experiment, when choosing the gathering coefficient, the following considerations are taken into account. According to the survey conducted among experts in clothing design, the minimum value of gathering coefficient, at which the sewn-on strip of fabric can be specified as ruffle, is 1.2. The maximum value of gathering coefficient, according to the experts in clothing design and measurement of ruffles on patterns and ready-made women`s dresses, is 2.4. The range of possible values of gathering coefficient 1.2 … 2.4 is divided into three equal intervals (Table 3). In each interval, the average value of the gathering coefficient is determined, which is selected for the experimental designs of the experimental study.

Table 3: General calculation of the gathering coefficient for experimental research

No.	Type of gathering	Gathering coefficient C_{gath}	The average value of C_{gath} in the interval
1	Small	1.20…1.59	1.4
2	Medium	1.60…1.99	1.8
3	Grandiose	2.00…2.40	2.2

The study of the knots is carried out after photographing them on a mannequin. The method of photographing the “mannequin – knot of clothing” system is organized under the same initial conditions in such a way that it is possible to assess the nature of the distribution of gatherings. The samples are placed along the mannequin`s waistline. The selection of the waistline is not accidental, because women`s clothes are often made detachable at the waistline with the formation of gatherings or folds. Also, the waistline is the thinnest part of the main part of the human figure, therefore, it is convenient to study the behavior of fabrics in this place; below the waistline, the product with gatherings falls freely, which allows studying the dependence of shape on the properties of fabrics.

Using different gathering coefficients, visually different results are obtained, which are unsatisfactory for some samples. The obtained photos are evaluated by experts. To assess the appearance of the “belt – gathering” snarl, the expert group of 10 experts is formed. All experts have higher education in the design of clothing, 6 of them have a Ph.D. in Engineering Science, 4 are Doctors of Engineering Science, and all have experience in the fashion industry and fashion education for at least 10 years. The experts are proposed to evaluate the quality of three volumetric forms of the gathering by the pictures. The experts evaluate each photo in points: 1 – the setting of the cloth is not satisfactory; 2 – the setting is satisfactory; 3 – the setting is good. The results of the expert evaluation are processed using the methods of mathematical statistics.

Results

Methodology of clothing design depending on the properties of textile materials

The process of clothing design includes several interdependent stages: from the formation of the task of creating a new model of clothing to the development of documentation for the model and its industrial production. The design of the shape and structure of clothing, as well as its manufacturability, both are significantly affected by such characteristics and properties of fabrics as raw material composition, type of weaving, thickness, surface density, type of final processing of material, rigidity, drapeability, the tendency to crease, and change in the linear dimensions of the material after wet-heat treatment. The properties listed above determine the selection of the design solution of the product, the values of the increments, technological allowances, the design of knots and connections, methods of shaping, etc.

The selection of the method of shaping depends both on the properties of the material and the shape of the product being designed. Depending on the shape of the product, the material required for its properties is selected. For example, the more rigid and thicker fabrics are selected for the clothes of large volumetric forms. In heavy and massive silhouette forms, it is advisable to focus the attention on the design solution of the product, choosing a simple geometric silhouette and minimizing the amount of decoration and design and decorative elements. For raincoats fabrics, various silhouettes of clothing are usually used with simple divisions and a minimum amount of decoration, which creates streamlined shapes and emphasizes the features of the texture of the material.

For costume fabrics, clear silhouette forms are often used, since they have a sufficient level of rigidity to ensure a given shape and high relaxation characteristic, therefore, the use of functional design and decorative elements is also relevant. The products from dress and shirt fabrics are considered the most diverse in terms of design and decoration. For example, thin light fabrics are often used in the production of evening wear for women, which create a soft, not massive shape of the product. In the evening wear, the emphasis is mainly on the texture of the material and decoration, because the main requirement is aesthetics.

For light shirt fabrics, it is advisable to choose medium-volume and low-volume plastic shapes since such fabrics have pure rigidity and are well-draped. In texture, most shirt fabrics are smooth, therefore, it is advisable to use the artistic decoration of products, such as folds, draperies, product divisions, and design and decorative elements. Knitted fabric is characterized by a fit or emphasis on an emphasized free shape of the product. Knitted garments are often decorated with printed designs, patches, or a small amount of decoration to avoid overdecoration of the product composition, as the structure of the knitted fabrics is already a compositional accent. Therefore, in knitted garments, a minimum amount of design and decorative elements is used. The characteristics of the recommended shapes of clothing made of various materials are given in Table 4.

Table 4: Characteristics of shapes of clothing made from different materials

Characteristic of the shape of clothing	Assortment group of fabric					
	Corset and under wear fabrics	Shirt fabrics	Dress fabrics	Costume fabrics	Coat fabrics	Raincoat fabrics
Degree of adherence	adjacent, semi-adjacent, straight, extended	adjacent, semi-adjacent, straight	adjacent, semi-adjacent, straight, extended	semi-adjacent, straight,	semi-adjacent, straight, extended	semi-adjacent, straight, extended
Geometric shape	X-shaped, rectangular, trapezoidal	X-shaped, rectangular, trapezoidal, oval	X-shaped, rectangular, trapezoidal, oval,triangular	X-shaped, rectangular,trapezoidal, oval, triangular	rectangular, trapezoidal, oval,triangular	X-shaped, rectangular,trapezoidal, oval, triangular
Plasticity of the silhouette	soft	soft	soft, tough	soft, tough	soft, tough	tough
Voluminosity and massiveness of shape	flat, light, small	flat small, light volumetric, light smooth,or texture	flat and voluminous,light small, texture	flat and voluminous massive,light smooth	voluminous heavy, massive, smooth	flat,light, texture, or smooth
Presence of divisions, decoration	tucks, straight and curly textures, folds, gatherings, draperies	tucks, straight and curly textures, folds, gatherings, draperies	tucks, straight and curly textures, undercuts, yokes, folds, gatherings, draperies	tucks, straight and curly textures, undercuts, yokes, folds, gatherings it is not advisable to use draperies	straight and curly through textures, yokes, undercuts, folds it is not advisable to use tucks, draperies, and gatherings	tucks, straight through divisions, undercuts it is not advisable to use complex draperies

Classification of types of three-dimensional decoration of clothes

The authors have analyzed such fashion magazines as Vogue, Elle, Harper's Bazaar and, based on such information, carried out the analysis of fashion trends. The analysis of the types of decoration makes it possible to state that the decoration can be divided into flat, three-dimensional, and additional accessories [22]. The flat decoration is performed directly on the surface of the product parts, and the spatial shape of the material does not change. The three-dimensional decoration forms and modifies the three-dimensional shape of the product and its parts by changing the spatial arrangement of the materials. Additional clothing accessories are such decoration details as scarves, ties, flowers, necklaces, fichu, collars, cuffs, belts, etc. The modern consumer of clothing seeks unusual shapes, which are achieved by using innovative materials, various design solutions, and decorative decoration. One of the types of decoration that changes the relief of the surface of clothing and its shape is three-dimensional decoration. The use of various gatherings, folds, ruffles, pinches, etc. forms the aesthetic perception of clothes to a large extent, can significantly improve the quality and expand the range of modern products.

Nowadays, the collections of many Fashion Houses include designs with three-dimensional decorations; volantes and slings are a relevant type of decoration of products of a various assortment. Many designers decorate evening dresses with various three-dimensional decoration, others add small volantes to blouses and skirts. In their work, designers and Fashion Houses like Valentino, Alexander Mcqueen, Louis Vuitton, Miu Miu, Chanel, Elie Saab, and others demonstrate volantes of different sizes and shapes, of different materials, located along the lower part of dress or pants, on the sleeves, collar, back of the products, in products of different assortment, even in coats, etc. In recent years, designers often use three-dimensional decoration, such as ruffles, gatherings, drapery, volantes, folds, puffs, pinches, etc. even in denim products. Therefore, a generalized systematization of the three-dimensional decoration of clothing is developed and presented in Figure 1.

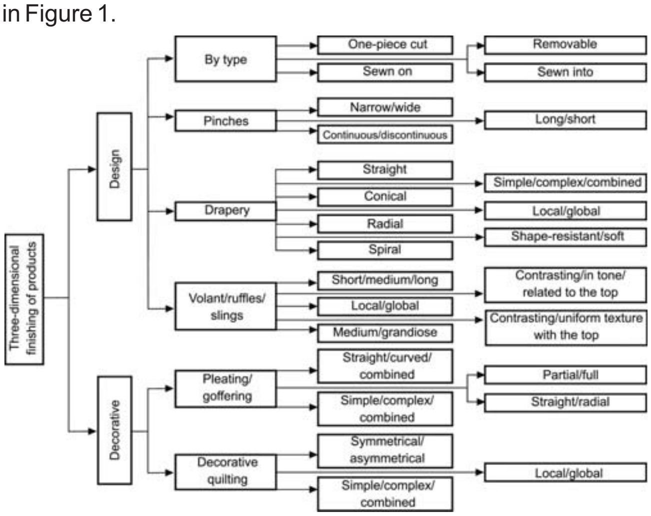

Figure 1: Systematization of three-dimensional decoration of products

It is known that three-dimensional decoration creates the shape of the product and its parts by changing the spatial arrangement of the materials. Three-dimensional decoration is divided into movable one, which provides some freedom to change the original shape (draperies, folds, ruffles, gatherings, plisse, gaufre, etc.); and fixed one, when the three-dimensional shape does not change and is usually fixed by using threads, interlinings, glue (buffs, pinches, decorative quilting (quilt), etc.).

Three-dimensional decoration is divided by the type of processing; it can be removable or sewn, which differs in the shape of the details of the cut. Examples of three-dimensional decoration are fichu and necklaces, ruffles, etc. The volantes can be simple or shaped, in the form of oval, spiral, or circle. The width and shape of volantes, slings, ruffles depend on the design and material of clothing. The volantes, unlike slings, are usually made wider, and due to this they create the illusion of movement on the surface of the product and affect the configuration and size of the main parts.

The results of the experimental study

The characteristics of nine samples of dress fabrics of different raw material composition and weaving, which differ in appearance, have been studied and the following physical and mechanical parameters are determined: thickness, surface density, drapeability, and rigidity. Therefore, the physical and mechanical parameters and characteristics of dress fabrics obtained as a result of the experimental study are presented in Table 5.

Table 5: Basic physical and mechanical characteristics of dress fabrics

Fabric sample	Raw materials [%]	Weave	Mass,g	Thickness, mm	Surface density, g/m2	Bending rigidity in warp, μN·cm2	Bending rigidity in weft, μN·cm2	Drapeability, %
F1	100% polyester	Harness-satin	1.98	0.34	198	2499	26444	45
F2	95% cotton /5% elastan	Harness-satin	1.91	0.37	191	14214	14214	59
F3	95% polyester/5% elastan	Harness-satin	1.44	0.30	144	511	438	83
F4	97% polyester/3% elastan	Harness-satin	1.77	0.31	177	3904	1657	62
F5	60% polyester/40% cotton	Harness-satin	2.02	0.37	202	730	730	73
F6	60% polyester/30% viscose/10% cotton	Plain	1.50	0.30	150	365	365	82
F7	80% cotton/20% polyester	Plain	0.85	0.21	85	292	292	83
F8	100% polyester	Plain	0.71	0.20	71	219	219	83
F9	100% polyester	Twill	2.20	0.50	220	1852	1224	69

The comparison of the obtained data on the thickness and surface density of the analyzed dress fabrics is presented in Figure 2. On average, the surface density of the studied fabrics ranges from 80 to 220 g/m2, which corresponds to the normative values for dress fabrics provided in the literature [21]. As can be seen in Figure 2, the surface density of the fabric is directly proportional to its thickness, i.e., the thicker the fabric, the greater its surface density. Samples of the fabric F1, F2, F5, and F9 are the thickest, hence, their surface density is the greatest.

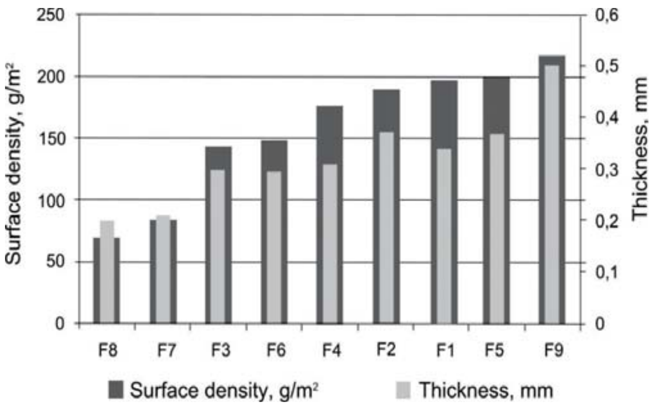

Figure 2: The comparison of surface density and thickness of dress fabrics

Comparing the values of drape coefficients of the analyzed fabrics, it can be concluded that sample F1 has the lowest ability to drape (45%), while samples F2 and F4 have higher indicators (59% and 62%). Samples F3, F6, F7, and F8 have the greatest ability to drape (83%, 82%, 83%, and 83% respectively). The drape coefficients of samples F5 and F9 vary within the range (73%, 69%). According to the Table 5, the samples of the fabric F1, F2, and F4 have a poor drape coefficient (<68%). Samples F5 and F9 have a satisfactory drape coefficient (68-80%). Samples F3, F6, F7, and F8 have a good draping coefficient, which is due to the fact that these samples of dress fabrics are the thinnest and more flexible compared to other samples.

Sample F8 has the lowest bending rigidity, while samples F1, F4, and F9 – the highest one. The bending rigidity in warp and in weft of both the samples F6 and F7 is less than of the samples F3 and F5 (Fig. 3, Fig. 4). In general, the drapeability of the studied samples is inversely proportional to their bending rigidity (Table 5).

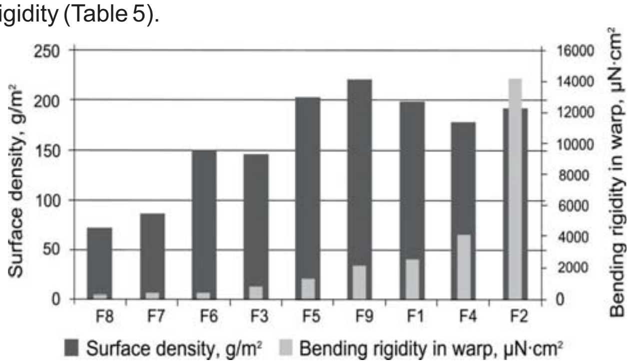

Figure 3: The comparison of surface density and bending rigidity in warp of dress fabrics

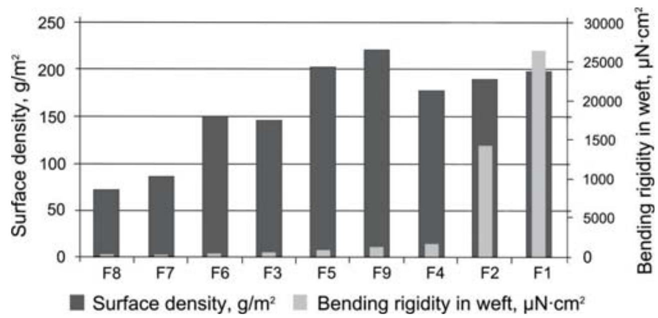

Figure 4: The comparison of surface density and bending rigidity in weft of dress fabrics

To analyze the behavior of fabrics of dress group in a product depending on their properties, the models of knots of clothes with gatherings are made. The photos of samples of knots with gatherings made of the analyzed dress fabrics are provided in Figure 5.

F1.1 F1.2 F1.3

F2.1 F2.2 F2.3

F3.1 F3.2 F3.3

F4.1 F4.2 F4.3

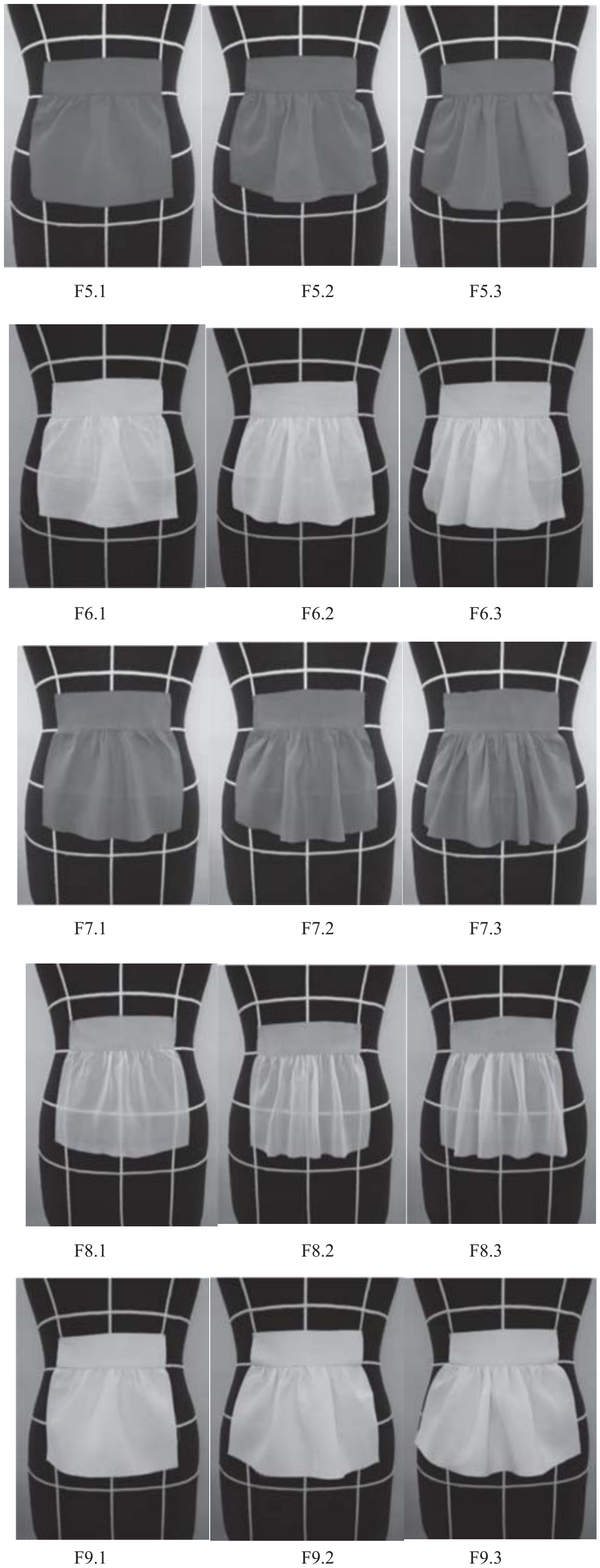

Figure 5: Samples of knots with gatherings made of dress fabrics (front view): the first mark is the number of the fabric sample; the second mark: 1 – gathering coefficient 1.4; 2 – gathering coefficient 1.8; 3 – gathering coefficient 2.2

The results of the expert evaluation given in Table 6. For each sample for each material, the average assessment is determined. The degree of the experts` consensus is determined with the help of the coefficient of concordance: w = 0,76. This shows the high level of consensus among the experts.

Table 6. The results of the expert evaluation of the samples with different gathering coefficient (Fig. 5)

Group of drapeability	Drape coefficient, %	Sample	C gath	Average value for the form of the volant		Recommended Cgath, degrees for the shape of the gathering	
				Conser-vative	Curva-ceous	Conser-vative	Curva-ceous
1	45	F1.1	1.4	1.5	1.0	-	2.2
		F1.2	1.8	1.3	1.2		
		F1.3	2.2	1.0	2.0		
	59	F2.1	1.4	1.7	1.2	1.8	2.2
		F2.2	1.8	2.6	2.4		
		F2.3	2.2	1.0	2.9		
	62	F4.1	1.4	2.3	1.0	1.4	2.2
		F4.2	1.8	1.6	2.6		
		F4.3	2.2	1.0	1.6		
	73	F5.1	1.4	2.5	1.0	1.4	1.8
		F5.2	1.8	1.8	2.7		
		F5.3	2.2	1.0	2.2		
	69	F9.1	1.4	2.4	1.0	1.4	1.8
		F9.2	1.8	2.0	2.6		
		F9.3	2.2	1.0	2.2		
2	83	F3.1	1.4	2.4	1.1	1.8	2.2
		F3.2	1.8	2.6	2.5		
		F3.3	2.2	1.1	3.0		
	82	F6.1	1.4	1.3	1.0	1.8	2.2
		F6.2	1.8	2.1	2.6		
		F6.3	2.2	1.0	2.9		
3	83	F7.1	1.4	2.2	1.0	1.8	2.2
		F7.2	1.8	2.8	2.6		
		F7.3	2.2	1.0	2.7		
	83	F8.1	1.4	2.3	1.0	1.8	2.2
		F8.2	1.8	2.9	2.8		
		F8.3	2.2	1.2	3.0		

Discussion

Recommendations on the gathering coefficient depending on the properties of fabrics

It is found that the greater the thickness and surface density of the fabric, the lower value of the gathering coefficient is recommended for gathering, or it is recommended to make designs from such fabrics without using three-dimensional decoration (except gatherings). Samples F1, F2, F5, F9 are determined as the thickest and largest in terms of their surface density; in addition, samples F2, F4, and F9 have the highest bending rigidity. For these samples, it is recommended to reduce the gathering coefficient to 1.7. In general, the samples have above average drapeability, and samples F3, F6, F7, F8 have a good one. Samples F7 and F8 are the thinnest, thus, the gathering coefficient for such fabrics should be 2.0 and more. The results of the evaluation are given in Table 7, and the last column provides recommendations on the gathering coefficient depending on the properties of fabric: thickness, surface density, drapeability, bending rigidity.

Table 7: Recommendations on the gathering coefficient for dress fabrics

Fabric sample	The best sample (photo, Figure 5)	Characteristics of fabric	Recommendations on the gathering coefficient
F1	F1.3	The fabric is thick and rigid, made of synthetic fibers, poorly draped.	Gatherings are not recommended.
F2	F2.2; F2.3	The fabric is natural, well-draped despite the medium rigidity. It holds its shape well.	Cgath = 2.0-2.5
F3	F3.3	Synthetic plastic fabric, not rigid, well draped.	Cgath =2.2-2.5
F4	F4.2	Quite dense, synthetic rigid fabric, medium draped.	Cgath ≤ 2.0
F5	F5.2	Mixed fabric, thick enough, which has a slight rigidity and medium drapeability.	Cgath ≤ 2.0
F6	F6.3	Mixed fabric, thin, well-draped, which has a slight rigidity. Due to the raw material composition, it holds its shape well.	Cgath ≥ 2.2-2.5
F7	F7.2; F7.3	Natural fabric, thin, well-draped, but not rigid and does not hold its shape.	Cgath = 2.0-2.5
F8	F8.2; F8.3	Thin chiffon fabric, well-draped, not rigid, very thin.	Cgath ≥ 2.0
F9	F9.2	Thick synthetic fabric, quite rigid, which has a medium drapeability.	Cgath ≤ 2.0 or designs without gathering

Analyzing the results of the research, provided in Table 5 and Table 6, it is found that the main indicator that affects the size of the gathering of the knot of the garment is the surface density of the fabric. The greater the surface density, the more fabric hangs under its weight in the product; in addition, usually, such fabrics have a greater thickness. For such fabrics, it is recommended to reduce the gathering coefficient. The comparison of the obtained samples shows that the rigidity also affects the ability of the fabric to be gathered. The fabric can be thin but quite rigid due to its weaving or raw material composition. For such rigid fabrics, it is also recommended to choose lower gathering coefficients.

The analysis of samples of the research fabrics is carried out to provide recommendations on the use of a certain type of decoration in the manufacture of women`s dresses. The fabrics of the samples F1, F4 have a satin weaving, of the sample F9 – twill one, from synthetic fibers, smooth-dyed. For these fabrics, it is not advisable to use such kind of three-dimensional decoration as gatherings, because they are very thick, rigid, poorly draped. Sample F2 consists of 80% cotton, 15% polyester, 5% elastane; the fabric is smooth-dyed with a satin weaving. For this fabric, it is advisable to use a three-dimensional decoration, because the fabric contains natural fibers, which helps it to hold its shape well.

Fabrics of samples F6 and F7 contain cotton with admixtures of synthetic fibers; they are smooth-dyed, have plain weaving, therefore, for these fabrics, it is advisable to use such types of decoration as volantes, gatherings, draperies, puffs, and other types of three-dimensional decoration. Sample F8 is a chiffon fabric with plain weaving and a raw material composition of 100% PE. As the fabric is thin and with low rigidity, it is recommended to make gatherings; but as the fabric is thin and does not hold its shape, so Cgath = 2.0-2.5. To sum up all the above, it is possible to recommend dress fabrics of samples F1, F5, and F9 to produce women`s dresses using the variety of decoration, but without gatherings, because their thickness, surface density, drapeability, and rigidity meet the specified needs. Samples F2, F3, F4, and F6 are recommended to produce summer dresses, for example dresses in a romantic style with the predominant use of three-dimensional decoration. Fabrics of samples F7 and F8 are recommended to produce blouses or dresses with a lining, as they are transparent, thin, and do not hold their shape. The recommended parameters for obtaining volantes [8] and ruffles of a certain shape are given in Table 8.

Table 8: The matrix of selection of design and decorative solutions of decoration details of women`s clothing depending on the properties of materials

Type of decoration	Design parameter	Property of the material	Characteristics of groups of fabrics	The average value of the parameter for the shape: medium	grandiose
Volant	angle of cutting		drape ability	150 150 200	200 200 250
Ruffle	gathering coefficient	drape ability	1) ≤ 68% 2) 68…80% 3) ≥80%	1.2-2.0 1.2-1.6 1.6-2.0	2.0-2.4 1.6-2.0 2.0-2.4

Conclusions

The methods of designing the clothes considering the properties of textile materials are presented, the design stages are described and the recommendations for the selection of compositional and constructive solutions depending on the group of materials are provided. The dependence of the gathering coefficient for knots of women`s clothing on the physical and mechanical properties of fabrics is analyzed on the example of fabrics of dress group. The properties of samples of dress fabrics of different raw material composition and weaving, which differ in appearance, are studied and their physical and mechanical parameters are determined, in particular thickness, surface density, drapeability, and rigidity. It is determined that the size of gathering of the knots of clothes made of dress fabrics depends on such properties of fabrics as thickness and bending rigidity. Also, the recommendations on the selection of the gathering coefficient in the modeling of knots of clothing made of different materials in the design of women`s clothing are provided.

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