ISSN 2181-8622

Manufacturing technology problems

Scientific and Technical Journal Namangan Institute of Engineering and Technology

INDEX COPERNICUS INTERNATIONAL

Google Scholar Crossref doi SLIB.UZ Scientific library of Uzbekistan

Volume 8
Issue 3
2023

PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY

UDC 687.016.5

DEVELOPMENT OF SHRINKAGE CALCULATION FOR MEN'S SHIRT BASE PATTERN MANUFACTURED BY THE GARMENT DYEING METHOD

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Abstract:

Objective. Traditionally, men's coloured cotton shirts are made from pre-dyed fabrics. However, in the clothing industry, some casual shirts with high hygienic properties are also produced by garment dyeing. In this article, drawing the base pattern and method of calculating the shrinkage values for selected cotton fabric to design of a men's shirt produced by the garment dyeing way has been researched, and the basic pattern based on the shrinkage values has been developed.

Methods. In order to draw the basic pattern of a men's shirt, M.Müller & Sohn's method was selected. This method offers convenience in constructing the base pattern, as it allows for the use of a few basic body measurements to build the basic pattern of various garments. In this approach, auxiliary measurements are derived using specific ratios of the main measurements, along with certain fixed values. By utilizing this technique, pattern construction becomes faster, requiring fewer body measurements and formulas. As a result, the design processes become more efficient, enhancing overall productivity.

Results. In order to design the drawing of the base pattern of the men's shirt, the necessary body measurements were determined according to the typical figure size 176-100-88 and the ease allowances were selected. According to abovementioned method, the base pattern of the shirt was made and a new formula was developed for calculating the values of shrinkage to it.

Conclusion. Garment dyeing is extensively utilized in warm climate countries like Uzbekistan for the production of cotton summer casual clothes in menswear. However, a thorough analysis of available sources reveals a lack of sufficient study and development of design principles for clothing production using this method.

Keywords: Clothing, shirt, design, casual, cotton, fabric, garment dyeing, shrinkage, pattern, body measurements, shirt block, ease allowance.

Introduction. One of the most important pieces of clothing in a modern man's wardrobe today is a shirt. Typically, shirts are a complementary element of a men's outfit, worn under suits, coats or jackets, but in seasons such as spring and summer, they are the main assortment of men's clothing. David Coffin describes a shirt as follows, any garment typically hangs from the shoulders, has a neckline, and is primarily shaped by the shoulder and side seams. It is usually a single-layer garment with a rectangular torso shape, although variations in design and tailoring can exist. Shirts typically do not have internal structure, padding, or interfacing, except in specific areas like collars or cuffs. The sleeves of a shirt generally project from the body at an angle, rather than falling parallel to it [1-2].

According to the function, shirts can be divided into uniform, casual or ceremonial clothes, as well as several different types according to the style, silhouette, shape, and again, depending on the season, they can be divided into spring-

autumn, summer and winter types. Men's shirt can be made from different materials: cotton, linen, silk, wool, artificial and mixed fibers. Fabrics vary in fiber, weave, and pattern, and colour can be plain, floral, striped, or checked [3-4]. Usually, spring-autumn shirts are made of cotton or cotton blend with artificial and synthetic fibers, with long sleeves and cuffs. For the summer season, it is mainly made from 100 percent cotton fabrics with high hygienic properties. For the winter season, it is usually made of thick or fluffy fabrics, for example flannel, wool, velvet. Coloured fabrics can be dyed at three stages of the manufacturing process: in the state of fiber or yarn; after weaving (fabric dyeing) and after sewing [5]. Fabric dyeing is the most widely used method and has been around for thousands of years, while garment dyeing has been developed since the 1970s -1980s and now accounts for almost 20% of the world's casual apparel production [6].

Garment dyeing refers to the process of dyeing complete garments, including items like pants, pullovers, t-shirts, trousers, sweaters, shirts, tops, casual jackets, dresses, skirts, and socks. This differs from the conventional method of producing garments using pre-dyed fabrics. In garment dyeing, the entire garment is dyed as a finished product, allowing for greater flexibility in color choices and the ability to achieve unique and varied effects. This method offers designers and manufacturers more creative freedom and enables them to customize the colors of garments according to their preferences or market demands [7-8]. That is, garments are made of grey fabric woven from cotton or cotton blended yarn, which has not undergone dyeing and other finishing processes, and then it is dyed in colors suitable for market and fashion requirements [9]. In this case, clothes are mainly made of cotton knitwear and cotton woven fabrics. The figure below shows the scheme of production of clothes by the method of post dyed clothes [10].

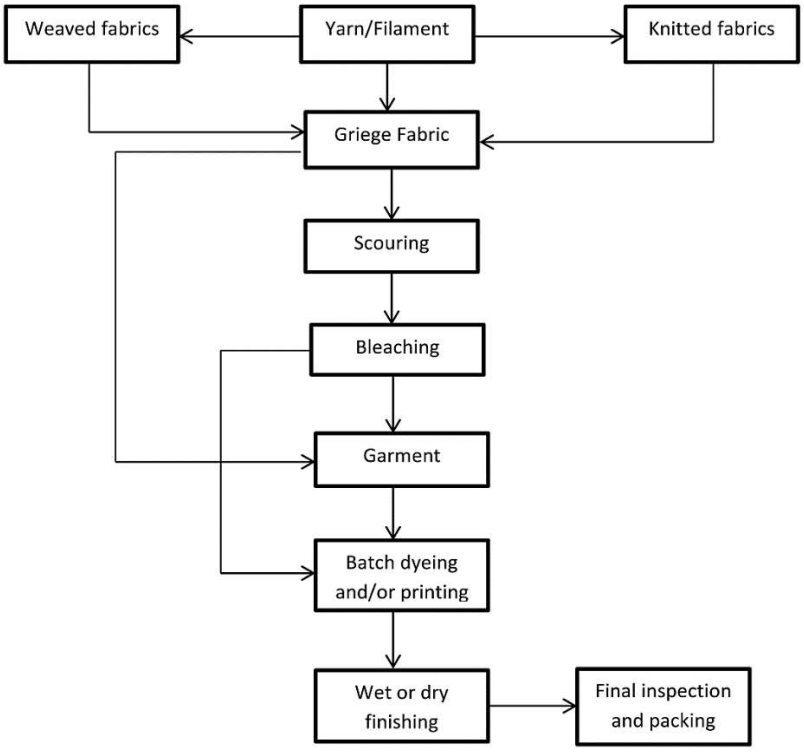

Figure 1. Flowchart of garment dyeing cycle

One of the major challenges faced when designing garments in this manner is the significant shrinkage of cotton fabric in both length and width during the garment dyeing process [11]. As a result, it becomes crucial to accurately measure the shrinkage values of the cotton fabric in advance and consider them during the design process in order to produce such clothes successfully. By factoring in the anticipated shrinkage, designers can ensure that the final garment retains its intended shape and size after the dyeing process. This proactive approach helps to minimize any potential issues that may arise due to the shrinkage of the fabric. For this purpose, in previous studies, experiments were done to determine the shrinking values of several cotton fabrics [12].

Table 1

Shrinkage percentage after dyeing of the chosen sample

Fabric	Yarn counts (Ne)	Weave	Shrinkage, %	
			warp	weft
Plain	CD30xCD30	1/1	9,4	8,5

Depending on the season, men's shirts produced by the garment dyeing are usually made of plain or twill woven cotton fabrics with 100-250 gr/m^2 weight. Also, fabrics such as satin, jacquard or other types and sometimes polyester fibers can be used. In the above table is given parameters of chosen sample intended for a shirt which in plain weave with a surface density of 120 gr/m^2. In order to develop the drawing of the basic pattern of shirt, the shrinkage values of this fabric were selected.

Methods. The "M.Müller & Sohn's method was chosen for the construction of the basic pattern men's shirt [13]. In the construction of base pattern, the convenience of using this method is that it is possible to build the construction of any items with a few basic body measurements (BM). In this case, the auxiliary measurements are found using certain ratios of the main measurements and some fixed values are used. This allows for faster pattern construction using fewer BM and formulas. This increases the efficiency of design processes.

Table 2

Basic measurements chart for men's dress shirt

Body measurements		Value	1/2	1/4	1/8
Bh	Body height	176,0	88,0	44	22
Cg	Chest girth	100,0	50,0	25,0	12,5
Wg	Waist girth	88,0	44,0	22	11
Ng	Neck girth	40,0			
Sl	Sleeve length	64,0			

According to these basic BM, the auxiliary measurements are found in the following. The depth and width of the scye, the width of back and chest are found by the chest girth – Cg. The length of the back piece till the waist Bwl and the length of the shirt Lg is determined by body height Bh specific proportions [14].

Table 3

Auxiliary measurements chart for men's dress shirt

Auxiliary measurements			Calculations	Ease	Final value
Nw	Neck width	6,7	1/6 Ng		6,7
Sd	Scye depth	22,0	1/10 Cg + 12,0 cm	4,0	26,0
Bwl	Back waist length	44	1/4 Bh	1,0	45,0
Ad	Armhole depth	27,0	Sd + 1		27,0
Bw	Back width	19,0	2/10 Cg – 1	2,0	21,0
Sw	Scye width	12,0	1/10 Cg + 2	2,5	14,5
Cw	Chest width	19,0	2/10 Cg – 1	1,5	20,5
Lg	Length	74,0	1/2 Bh – 14		74

The basic shirt block is the foundation for many different shirt styles and fits. Add the appropriate amount of ease according to the ease chart. The ease amounts can be varied but should be applied proportional for a well balanced look. A good example is the armhole in proportion to the overall width. A slim fitting shirt should not have a low armhole to allow for freedom of movement.

Table 4

Ease chart for men's dress shirt

Shirt fit		Slim fit	Regular	Loose fit
Sd	Scye depth	+ 3,0 to 4,0	+ 4,0 to 5,0	+ 5,0 to 6,0
Bwl	Back waist length	+ 1,0	+ 2,0	+ 3,0
Bw	Back width	+ 2,0	+ 2,5	+ 3,5
Sw	Scye width	+ 2,0 to 2,5	+ 3,0 to 3,5	+ 4,0 to 4,5
Cw	Chest width	+ 1,5	+ 2,0	+ 2,5
Total ease		+ 5,5 to 6,0	+ 7,5 to 8,0	+ 10,0 to 11,0

All measurements (table 2,3,4) above is given in centimeters and the base pattern of dress shirt has been constructed according to them and ease allowances was chosen as slim fit in table 4. In this base pattern, total ease of Cg comprised 6 centimeters.

Results and Discussions. The basic pattern construction of the shirt was drawn using Gemini Pattern Editor CAD software. Now it should be re-designed the pattern sections, taking into account the shrinking values of the garment dyeing process. In speciality books is not given information provided for the calculation of separate shrinkage values for the post dyed clothes, but in some sources [15-17] in the design of knitted products, it is also mentioned to take into account the technological addition for the shrinking after fabric wet processing in terms of length and width. The shrinkage rate is determined for each fabric by the experimental method or depending on the composition of the raw materials. The shrinking coefficient KU of the cloth is determined by the following formula:

$$K_U = 0{,}01 \cdot U \quad (1)$$

where: U is the shrinkage value for the length and width of the fabric, %.

The detail size B1 (Fig. 2), which takes into account the lengthwise shrinkage of the fabric in the process of

apparel producing (for example, during wet-heat treatment) or when washing, is determined using the following formula:

$$B_1 = B\ (1 + K_U) \qquad (2)$$

where: B is the detail size in the basic pattern drawing, cm; K_U is the shrinking coefficient of the fabric.

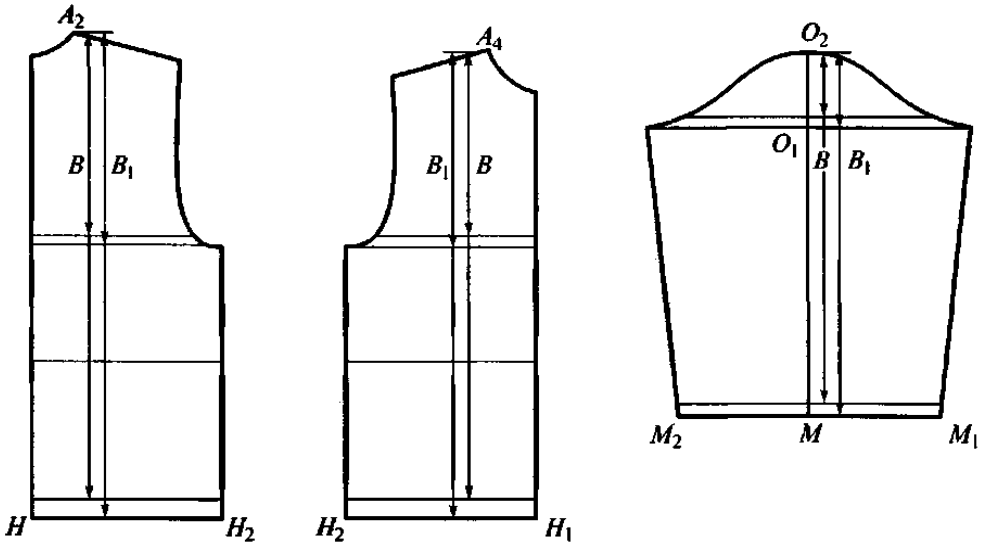

Figure 2. Changes in the length dimensions of the pattern blocks taking into account the fabric shrinkage

This formula performs a simple operation based on calculating and adding the amount of shrinking rate to the initial value in the pattern block, that suitable for determining the shrinkage value of any fabric. But the main drawback of this formula is that it does not take into account shrinkage of added input value $\Delta B=(B_1 - B)$. If the shrinkage value is determined according to the formula (2) and added to the pattern block, and the same B_1 is recalculated, the result will be not equal, therefore less than B:

$$B_1 = (1- K_U) \neq B \qquad (3)$$

This fault may not be noticeable in fabrics with a small 2-3 percent shrinkage, but in garment dyeing, given that cotton fabrics have average from 5 to 15 percent shrinkage, this leads to a significant error (fig.3) between the initial values of the basic pattern, which should be consistent with the dimensions after the final dyeing. Therefore, the following formula was proposed, which also takes into account the shrinkage value of ΔB:

$$\Delta B=B_1 - B = B+B\cdot K_U - B=B\cdot K_U$$

$$B`_1= B+B\cdot K_U +B\cdot K_U \cdot K_U =B\ (1 + K_U + K_U^2) \qquad (4)$$

The graph below shows the calculated fault of the results computed by both formulas at different shrinking ratios of fabrics.

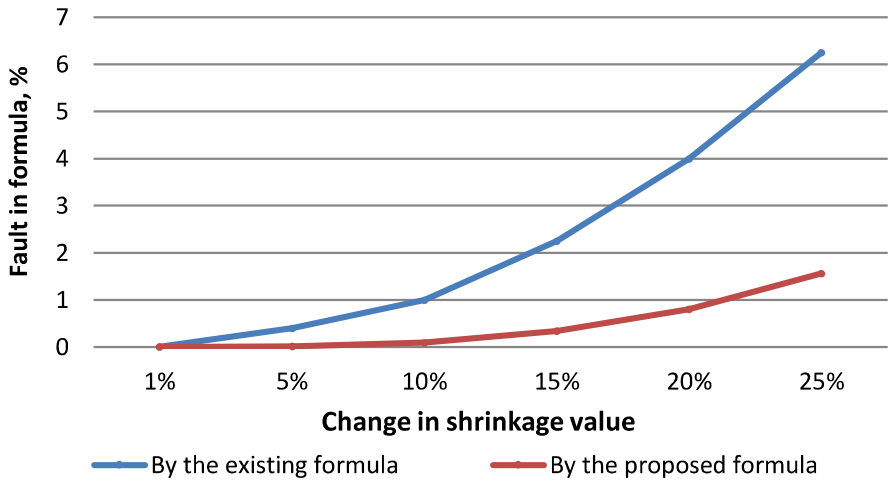

Figure 3. Deviation graph of existing and proposed formulas shrinkage value calculation for pattern block

As shown in the graph, if added values for shrinkage are calculated using formula (4), it was found that the accuracy of base pattern construction increases from 87 percent to 97 percent in cotton fabrics with shrinkage from 15 percent to 5 percent. It is considered sufficient, as it is much smaller than the permissible maximum deviations [18] from nominal size in a shirt. The figure below shows a redesigned drawing and layout of shirt pattern with shrinkage parameters.

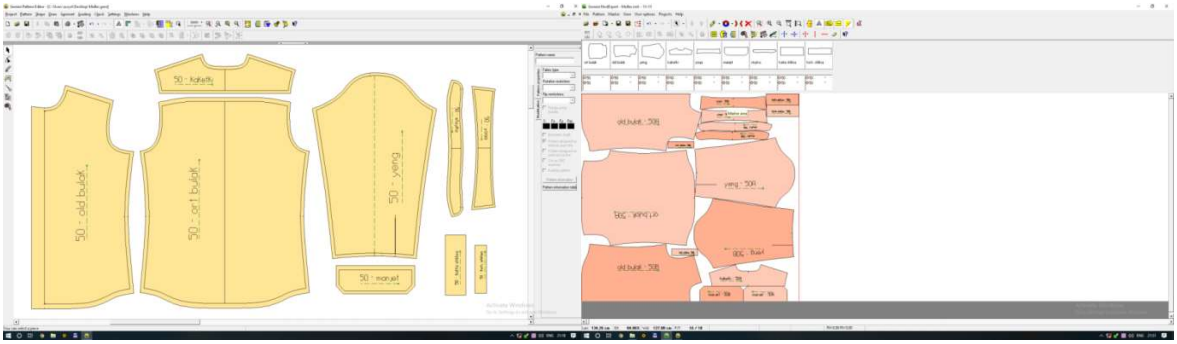

Figure 4. Pattern development and layout of men's shirt in the Gemini CAD program with calculated shrinkage values

Conclusion. Worldwide, about 20% of casual clothes are produced by garment dyeing, especially in countries with a warm climate like Uzbekistan, it is widely used in cotton clothes in the production of summer clothes. However, as a result of a detailed study of open sources, it became clear that the design principles of clothing production by the method of postdyed clothes have not been sufficiently studied and developed. In order to solve these problems, the above research was carried out and a calculation method was developed for the design of the men's shirt base pattern according to the determined shrinkage parameters of the fabric. In the next study, it is planned to determine the compatibility of the shirt sizes designed according to the above parameters with the initial nominal sizes after dyeing process, and to develop a measuring method.

References

1. Coffin, D.P. The shirtmaking workbook Pattern, Design, and Construction Resources/ D.P. Coffin // Creative Publishing Int, 2015, p. 6
2. Coffin, D.P. Sewing shirts for a perfect fit : the ultimate guide to fit, style, and construction from collared and cuffed to blouses and tunics / David Coffin// Quarry Books, 2019, p. 12
3. J.S.Sidikjanov. Study fabrics of men's shirts. SCIENCE AND INNOVATION INTERNATIONAL SCIENTIFIC JOURNAL. VOLUME 2 ISSUE 2, 2023, p. 245
4. Shirt Fabric Weaves Guide. Internet source: https://www.batchmens.com/pages/dress-shirt-fundamentals-shirt-fabrics-andweaves-guide
5. Chakraborty J N. Fundamentals and Practices in Colouration of Textiles. Woodhead Publishing India Pvt. Ltd., 2014, India. 365-367.
6. Bone J.A., Collishaw P.S., Kelly T.D., "Garment Dyeing" Review Progress in Coloration 18, 1988, pp. 37–38
7. Fergusson S. MacA. Garment-finishing techniques /Garment Manufacturing Technology// Edited by Nayak R., Padhye R. Elsevier Ltd., 2015, Cambridge, UK. p.391
8. J.N.Chakraborty, Rudrajit Pal, P.R.Megha. Garment dyeing // Indian Journal of Fibre & Textile Research, Vol. 30, December 2005, pp. 468
9. Textiles and Fashion. Materials, Design and Technology. Edited by Sinclair R. Elsevier Ltd., 2014, Cambridge, UK. p. 500
10. M Shoeb Khan. Textile research and development. Source: https://www.researchgate.net/publication/272352549. 2013, p. 7
11. Gore G.C., "Practical Experiences in Garment Dyeing – Problems and Solutions", Textile Chemist and Colorists 27 (3) 1995 37 – 40
12. J.S.Sidikjanov, N.N.Nabidjanova. Analysis the shrinkage of different cotton fabrics in the dyeing process of garment. JournalNX- A Multidisciplinary Peer Reviewed Journal. VOL. 8, ISSUE 6, 2022, p. 142
13. Fundamentals menswear. System M. Müller & Sohn | Published by Ebner Media Group GmbH & Co. KG | https://www.muellerundsohn.com/en/shop/fundamentals-menswear/ 2020, pp.60-73
14. Pattern Making Men's Dress Shirts. System M. Müller & Sohn | Published by Ebner Media Group GmbH & Co. KG | https://www.muellerundsohn.com/en/shop/ 2022, pp.10-15
15. Кузнецова Jl. А., Казакова З. Ф. Карцева А. А. Конструирование трикотажных изделий. «Легкая индустрия»,· 1972, ст. 102
16. Sh.G.Madjidova, G.D.Ulkanbayeva. Technology of knitwear/ Tikuv–trikotaj buyumlari texnologiyasi // Tashkent. 2018, p. 47
17. Н.М.Конопальцева, П.И.Рогов, Н.А.Крюкова. Конструирование и технология изготовления одежды из различных материалов. «Академия» Москва 2007, ст. 134
18. GOST 30327-2013. Shirts. General specifications /International Standart// Interstate Council For Standardization, Metrology And Certification (Isc), Moscow. 2014, p.6

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