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МРНТИ 64.33.17 https://doi.org/10.48184/2304-568X-2024-2-190-196
УДК 687.1

IMPROVEMENT OF THE TECHNOLOGY OF MANUFACTURING CLOTHES OF LAW ENFORCEMENT AGENCIES

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Special requirements are imposed on the uniform of a serviceman due to the specific use in different conditions. Special attention is paid to the comfort of wearing, the quality of materials and construction of clothing, hygienic and tactical and technical properties. When designing thermal protective clothing, it must be borne in mind that its thermal resistance must ultimately be assessed by the cumulative insulating effect of the finished structure. This scientific article attempts an in-depth analysis of the study of the problem of choosing the best range of

materials necessary for the manufacture of uniforms intended for use in law enforcement agencies. The purpose of this study is to carefully determine the optimal combination of materials that is guaranteed to ensure a high standard of quality, durability and functionality of the uniform, as well as compliance with its requirements for modern service conditions. The article analyzes various aspects that affect the choice of materials, including their strength, comfort, protective properties and aesthetic aspect. The obtained research results, in turn, are aimed at improving the process of developing and manufacturing uniforms for law enforcement agencies, which, ultimately, will lead to an increase in the level of comfort and safety for its future wearers.

Keywords: power structures, research and selection of material package, material characteristics, thermal insulation properties of clothing.

КҮШ ҚҰРЫЛЫМДАРЫНЫҢ КИІМДЕРІН ДАЙЫНДАУ ТЕХНОЛОГИЯСЫН ЖЕТІЛДІРУ

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Әскери қызметшінің нысанына әртүрлі жағдайларда нақты пайдаланылуына байланысты ерекше талаптар қойылады. Киімнің ыңғайлылығына, материалдардың сапасы мен киімнің дизайнына, гигиеналық және тактикалық-техникалық қасиеттеріне ерекше назар аударылады. Жылудан қорғайтын киімді жобалау кезінде оның жылу кедергісі, сайып келгенде, дайын құрылымның жиынтық оқшаулау әсерімен бағалануы керек екенін есте ұстаған жөн. Бұл ғылыми мақалада күш құрылымдарында қолдануға арналған форманы жасау үшін қажетті материалдардың ең жақсы ассортиментін таңдау мәселесін терең талдауға тырысады. Бұл зерттеудің мақсаты форманың жоғары сапа стандартын, беріктігі мен функционалдығын, сондай-ақ оның қазіргі қызмет жағдайларына қойылатын талаптарға сәйкестігін қамтамасыз ететін материалдардың оңтайлы комбинациясын мұқият анықтау болып табылады. Мақала материалды таңдауға әсер ететін әртүрлі аспектілерді, соның ішінде олардың беріктігін, жайлылығын, қорғаныс қасиеттерін және эстетикалық аспектісін талдайды. Зерттеу нәтижелері өз кезегінде күш құрылымдары үшін форманы әзірлеу және өндіру процесін жақсартуға бағытталған, нәтижесінде оның болашақ тасымалдаушылары үшін жайлылық пен қауіпсіздік деңгейі артады.

Негізгі сөздер: күш құрылымдары, материалдар пакетін зерттеу және таңдау, материалдардың сипаттамалары, киімнің жылу оқшаулау қасиеттері.

УСОВЕРШЕНСТВОВАНИЕ ТЕХНОЛОГИИ ИЗГОТОВЛЕНИЯ ОДЕЖДЫ СИЛОВЫХ СТРУКТУР

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К форме военнослужащего предъявляются особые требования ввиду специфического использования в разных условиях. Особое внимание уделяется удобству при носке, качеству материалов и конструкции одежды, гигиеническим и тактико-техническим свойствам. При проектировании теплозащитной одежды необходимо иметь в виду, что ее тепловое сопротивление в конечном счете должно оцениваться совокупным изолирующим действием готовой конструкции. В настоящей научной статье предпринимается попытка глубокого анализа исследования проблемы выбора наилучшего ассортимента материалов, необходимых для изготовления униформы, предназначенной для использования в силовых структурах. Цель данного исследования заключается в тщательном определении оптимальной комбинации материалов, которая гарантированно обеспечит высокий стандарт качества, долговечность и функциональность униформы, а также соответствие ее требованиям, предъявляемым к современным условиям службы. В рамках статьи происходит анализ различных аспектов, влияющих на выбор материалов, включая их прочность, комфорт, защитные свойства и эстетический аспект. Полученные результаты исследования, в свою очередь, направлены на улучшение процесса разработки и производства униформы для силовых структур, что, в конечном итоге, приведет к повышению уровня комфорта и безопасности для ее будущих носителей.

Ключевые слова: силовые структуры, исследование и выбор пакета материалов, характеристики материалов, теплоизоляционные свойства одежды.

Introduction

Currently, there is a growing global trend in consumer demand for military uniforms with high levels of operational reliability. Many enterprises possess extensive knowledge and experience in the design and manufacturing technology of clothing. However, many enterprises currently select materials based solely on previous experience and knowledge, overlooking the emergence of innovative materials in the market. Therefore, a comprehensive study of optimal material packages for outerwear in law enforcement is needed. Based on this study, it is essential to develop a fundamentally new package of materials that meets increased requirements while remaining affordable.

The production of military clothing has a long history, dating back to the times of ancient civilizations. Today, the production of military clothing is concentrated in the hands of several large companies, such as American Apparel, Propper International, Crye Precision and others. They offer a wide range of products for various military branches and government services. Technologies and materials used in the production of military clothing are constantly being improved and updated. The production of military clothing for the Kazakhstan army is undertaken by several companies, including Kazakhstan Paramount Engineering and Astana Group, which manufacture various types of military equipment such as uniforms, helmets, body armor, and other components. Additionally, Kazakhstan exports its military clothing to Russia and other CIS countries [1, 2].

An analysis of the problems and potential of the textile industry in Kazakhstan may include the following aspects:

- low competitiveness - Kazakhstan's textile industry faces low competitiveness on a global scale due to high costs of energy, raw materials and transportation. In addition, the lack of modernization and innovation in the industry is affecting the quality of products;

- dependence on imported raw materials - the textile industry of Kazakhstan has a high dependence on imported raw materials such as cotton, wool, polyester, which leads to increased production costs;

- lack of qualified labor - the lack of specialized training and low wages in the textile industry leads to an outflow of qualified personnel, which affects the quality of products and the competitiveness of the industry;

- insufficient support from the state - the lack of government investment and preferential programs for the textile industry limits its development and reduces competitiveness in the world market. Despite these problems, the textile industry in Kazakhstan has potential for development [3-7].

The purpose of this research is to develop an optimal outerwear package for law enforcement agencies with high ergonomic, aesthetic, economic, protective and hygienic properties.

Materials and research methods

Types of military uniforms are divided into: ceremonial, casual, field and special. By type, military uniforms are summer, winter and demi-seasonal. For everyday wear, servicemen are provided with a casual uniform. Field uniforms are intended to be worn when performing special, combat and combat training tasks, as well as during exercises. Special uniforms provide for the functionality of clothing parts when performing special, combat and combat training tasks (pockets, ammunition mounts for ammunition, weapons, military equipment, quick-drop systems, articles of clothing). The ceremonial uniform is for formation when participating in parades, presenting Battle Banners to military units, presenting state awards to servicemen and awarding the highest officer rank, as well as at ceremonial rallies [8]. Figure 1 shows the range of military uniforms of the RK.

Figure 1. Assortment of the Respublic of Kazakhstan military uniforms

According to GOST 19701-74, outer fabrics can be pure wool and half-woolen fabrics, these include worsted fabrics. For lining fabrics, standards from GOST 6391-80 are used - these are fabrics made from viscose (for example, silk) and synthetic (for example, satin) threads. GOST 5665-77 is used for cushioning fabrics - sideboard, linen, and half-linen [9, 10]. These may include board cloth, dublerin, etc. Special requirements are imposed on a serviceman's uniform due to its specific use in different conditions. Special attention is paid to wearability, quality of materials and construction, hygienic and tactical-technical properties. When designing thermal protective clothing, it is necessary to keep in mind that its thermal resistance should ultimately be evaluated by the total insulating effect of the finished structure. Thermal protective properties of clothing are determined by the thermal resistance of the materials of the package, as well as the presence of air layers in it. The greatest importance in the thermal insulation of a person belongs to the thermal resistance of the package of materials, the design of clothing is given an additional role, although not insignificant. The thermal insulation properties of a garment are largely determined by the thickness of its package, shown in Figure 2, which includes the thickness of materials and the thickness of air layers. Based on this, it was to be expected that by increasing the thickness of air layers in the garment, its thermal resistance can be increased [11-16].

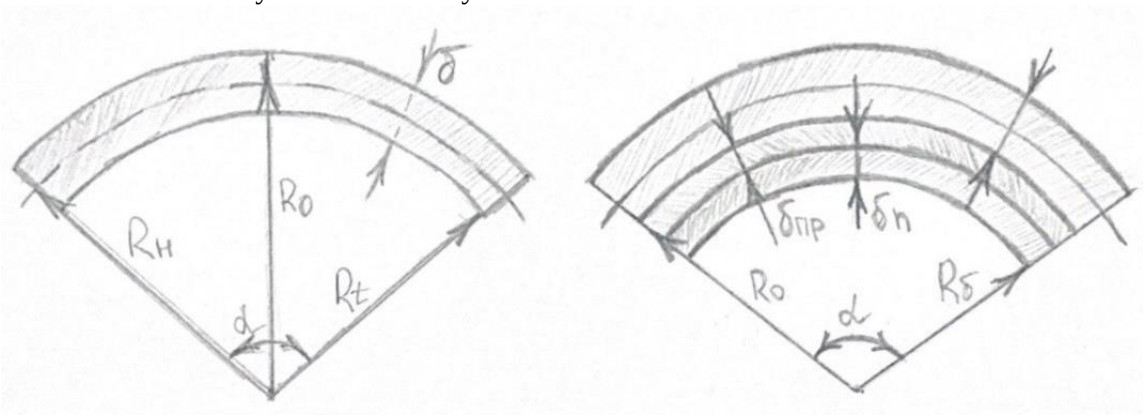

Figure 2. Visualization of a single-layer and multi-layer clothing package

Taking the horizontal section of the torso of the human figure (Fig. 2) as a circle and considering the clothing as a circular ring around the body, the allowance for the thickness of the materials of the clothing package At.m. can be determined approximately for the inner layers by the formula 1:

$$A_{T.M} = \alpha R_{\text{н}} - \alpha R_B = \alpha(R_{\text{н}} - R_B) = \alpha(R_{B+}\,\delta - R_B) = \alpha\delta \quad (1)$$

and for the outer layer by formula 2:

$$A_{T.M} = \alpha R_0 - \alpha R_B = \alpha(R_0 - R_B) = \alpha(R_0 - R_0 + \frac{\delta}{2}) = \alpha\frac{\delta}{2} \quad (2)$$

where:

α — the central angle constricting the arc of the circle covered by the clothing, in radians;

δ — average total material thickness of the garment package, taking into account the unequal number of fabric layers in different areas (presence of a side pad located only across the chest width and different thickness of the side pad), cm;

$R_{\text{н}}$ — arc radius of the outer layer of the clothing package;

R_B — radius of the inner layer of the clothing package;

R_0 — radius of the middle layer of the clothing package.

From formula 3, calculations can be made taking into account the multilayer nature of the clothing package:

$$A_{T.M} = \alpha\left(\delta_{\text{п}} + \delta_{\text{пр}} + \delta_{y.\text{п}p}\right) + \alpha\frac{\delta_{0.\text{т}}}{2} = \alpha\left(\delta_{\text{п}} + \delta_{\text{пр}} + \frac{\delta_{0.\text{т}}}{2}\right) + \alpha\delta_{y.\text{п}p} \quad (3)$$

where:

Ат.м — the overall allowance for the thickness of the clothing material package, cm;

$\delta_п$ — pad thickness, cm;

$\delta_{пр}$ — thickness of the stiffening cloth pad, cm;

$\delta_{у.пр}$ — thickness of insulation pad, cm;

$\delta_{о.т.}$ — thickness of the main fabric (top), cm.

To select the optimal package of fabrics according to technical indications, the following materials, which are used for the production of departmental clothing, were investigated:

- for the outer fabric: semi-wool, wool, blended fabrics, gabardine, as specified in Table 1;
- for the lining fabric: taffeta, carded satin, twill, as specified in Table 2;
- for the interlining fabric package: front interlining and low-shrinkage fabric, dublerin, vlieseline, fusible web, as specified in Table 3;
- for the finishing fabric: cloth, as specified in Table 4.

Table 1. Comparative table of outer fabric characteristics

Fabric	Physical and mechanical properties				Price, kzt.
	Hygroscopicity, %	Density, g/m	Air permeability, m/m²sec	Tensile load, H	
1	2	3	4	5	6
Semi-wool	10-30	200-500	30-100	200-600	2800
Wool	30 or higher	250-800	60-200	300-900	7700
Blended fabrics	5-20	200-600	50-150	250-700	1100
Gabardine	5-10	300-700	40-120	200-600	600

Table 2. Comparative table of lining fabric characteristics

Fabric	Physical and mechanical properties				Price, kzt.
	Hygroscopicity, %	Density, g/m	Air permeability, m/m²sec	Tensile load, H	
1	2	3	4	5	6
Taffeta	less than 10	52	30-60	350-700	850
Carded sateen	6-8	120-180	30-150	100	1000
Twill	6-8	100-300	50-150	44-140	1200

Table 3. Comparative table of characteristics of interlining fabrics

Fabric	Physical and mechanical properties				Price, kzt.
	Hygroscopicity, %	Density, g/m	Air permeability, m/m²sec	Tensile load, H	
1	2	3	4	5	6
Stiffening pad fabric	less than 1	20-100	less than 1	50-200	1150
Stiffening low-shrinkage fabric	less than 1	40-100	less than 1	50-200	1350
Dublerin	6-12	100-200	less than 30	175-525	1500
Vlieseline	5-10	20-100	less than 30	3-5	950
Fusible web	less than 1	20-100	less than 1	3-5	1000

Table 4. Table of finishing fabric characteristics

Fabric	Physical and mechanical properties				Price, kzt.
	Hygroscopicity, %	Density, g/m	Air permeability, m/m²sec	Tensile load, H	
1	2	3	4	5	6
Cloth	1-5	320-450	less than 30	1050-1750	4900

Table 5 summarizes the characteristics of various material packages. Based on the data presented in the table, it can be concluded that the package comprising semi-wool, taffeta, and dublerin exhibits the most favorable technical parameters.

Table 5. Characteristics of material packages comparison

Package	Components	Measurement area, cm^2	Experiment duration, sec	Air permeability, m/m^2sec
1	2	3	4	5
Main fabric Interlining fabric Lining fabric	Semi-wool Dublerin Taffeta	20	60	467,8
Main fabric Interlining fabric Lining fabric	Ripstop 1 layer of camel wool Cotton	20	60	409,5
Main fabric Interlining fabric Lining fabric	Ripstop 1 layer of camel wool Polyester	20	60	455,5
Main fabric Interlining fabric Lining fabric	Ripstop 2 layers of camel wool Viscose	20	60	460,8
Main fabric Interlining fabric Lining fabric	Garant 1 layer of camel wool Cotton	20	60	393,3
Main fabric Interlining fabric Lining fabric	Garant 1 layer of camel wool Cotton	20	30	463,3
Main fabric Interlining fabric Lining fabric	Gretta №1 2 layers of camel wool Polyester (antistatic)	20	30	465

Results and discussion

Throughout the research, the following criteria for the fabric package were identified, indicating that the optimal choice entails a combination of the following fabrics: wool blend, taffeta, and dublerin. Each of these materials contributes uniquely to the quality and functionality of the uniform. The wool blend offers wear resistance and thermal insulation, rendering the uniform suitable for diverse climates. Taffeta, prized for its strength and lightness, enhances the product's comfort and durability. Dublerin is utilized to impart shape and additional rigidity to uniform elements, crucial for maintaining a polished appearance under rigorous usage conditions. These fabrics are selected for their blend of durability, functionality, and aesthetic appeal, rendering them exemplary for crafting high-quality uniforms.

Conclusion

The conducted research has enabled the identification of the optimal fabric combination for crafting high-quality uniforms. Analysis revealed that integrating a wool blend, taffeta, and dublerin in uniform production achieves an ideal equilibrium between strength, functionality, and aesthetic appeal. This approach ensures resilience to wear, thermal insulation, user comfort, shape retention, and enhanced durability. Consequently, the devised material blend represents the optimal solution for producing high-caliber uniforms that adhere to military standards while prioritizing wearer comfort and safety.

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