INFORMATION SUPPORT FOR FORMING THE ASSORTMENT OF INDUSTRIAL WORKWEAR

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Abstract. The article addresses issues related to developing the information-methodological support for the decision-making process in forming an assortment of industrial workwear. A structure for an information-search process is proposed, which, at the initial design stage, enables the search for graphic solutions for workwear models based on identifying optimal zones of soiling and wear that correspond to real operational conditions. A graphic database of various constructive-technological solutions has been developed, allowing for the expansion of functional modules in automated systems. The use of a graphic representation database in the automated design of an industrial workwear collection significantly reduces the time required for developing model designs and decreases the number of errors caused by the human factor.

Keywords: special-purpose clothing, graphic solution, design, soiling zone, automated systems.

Annotatsiya. Maqolada ishlab chiqarish kiyimlari assortimenti shakllantirish bo‘yicha qaror qabul qilish jarayonining axborot-metodik ta’minotini ishlab chiqish masalalari yoritilgan. Loyihalashning dastlabki bosqichida real ekspluatatsiya sharoitlariga mos ravishda kiyimning kir va eskirish sohalarining optimal zonalarini aniqlash asosida ishlab chiqarish kiyim modellarining grafik yechimlarini izlashni ta’minlovchi axborot-qidiruv jarayoni tuzilmasi taklif qilingan. Avtomatlashtirilgan tizimlar funksional modullarini kengaytirish imkonini beruvchi turli konstruktiv-texnologik yechimlarning grafik bazasi ishlab chiqilgan. Ishlab chiqarish kiyimlari kolleksiyasini avtomatlashtirilgan loyihalashda grafik ko‘rsatish bazasidan foydalanish model dizaynini ishlab chiqish vaqtini sezilarli darajada qisqartiradi va inson omili tufayli yuzaga keladigan xatolar sonini kamaytiradi.

Kalit so‘zlar: maxsus kiyim, grafik yechim, dizayn, kir zonalari, avtomatlashtirilgan tizimlar.

Аннотация. В статье освещены вопросы разработки информационно-методического обеспечения процесса принятия решений по формированию ассортимента производственной одежды. Предложена структура информационно-поискового процесса, обеспечивающая на начальном этапе проектирования поиск графических решений моделей производственной

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одежды на основе определения оптимальных зон загрязнения и износа одежды в соответствии с реальными условиями эксплуатации. Разработана графическая база различных конструктивно-технологических решений, позволяющая расширить функциональные модули автоматизированных систем. Использование базы графического представления при автоматизированном проектировании коллекции производственной одежды значительно сокращает время разработки дизайна моделей и уменьшает количество ошибок, вызванных человеческим фактором.

Ключевые слова: специальная одежда, графическое решение, дизайн, зоны загрязнения, автоматизированные системы.

Introduction

Today, global advancements in science and technology offer broad possibilities for producing competitive, high-quality special-purpose clothing, including innovative materials with high protective indices, rapid assortment renewal, and increased production efficiency focused on the intellectualization of design based on automated design systems (ADS). With the intensification of technological competition, the importance of interactive, customer-oriented design is growing not only for household items but also for industrial workwear. To solve the complex formalizable problems of interactive clothing design, methods based on artificial intelligence have been proposed to enhance the creative work of designers and engineers [1]. Work [2, 3] proposed an information system that provides the capability to solve project-organizational tasks for special clothing that meets the full and stratified needs of various professional-production groups, and created a data-search apparatus to support the creative process of developing clothing models for established professional groups. However, the proposed information support for forming a workwear assortment does not ensure solving the task of creating sketches based on the direct dependence of the search for constructive-decorative and technological elements on the factors of soiling and wear of the garment. Therefore, there is a need to solve the task of expanding the functional modules of automated systems to develop original solutions for special clothing that extend and predict its service life in accordance with standard requirements at the initial design stage.

METHODS

This article addresses the development of information-methodological support for the decision-making process in forming an assortment of industrial workwear. A structure for an information-search process is proposed, which, at the initial design stage, enables the search for graphic solutions for industrial workwear models based on identifying optimal zones of soiling and wear that correspond to real operational conditions.

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The input data for the information-search process of creating a clothing sketch include: specific job positions at an enterprise, graphical data on garment soiling zones according to the position, types and property indicators of materials, and assortment units of clothing. The formation of a graphic representation database is based on the presentation of the basic form and silhouette of the special garment, as well as the constructive-decorative and technological elements of the assortment unit. The formation of sketches in the selected basic structure is determined by the relationship between graphical data on soiling zones and the constructive-decorative and technological elements. Solving this task is based on developing methods that enable the "recognition" of model graphic solutions corresponding to soiling zones identified according to occupational positions. The implementation of recognition methods is carried out using expert knowledge that establishes the visual graphic representation of the clothing model.

Based on a comparison of graphical data on soiling zones and the parameters of the graphic solutions of the designed model according to the basic shape of the garment, a modification coefficient is determined that reflects changes in the parametric values of the item's shape and constructive lines. By varying the color solution, various stylized versions of the transformed image of workwear sketches are obtained, preserving the integrity of the image while rationally utilizing protective materials.

To evaluate the compositional solutions of clothing models, it is necessary to optimize the change in compositional-constructive parameters. As the research object for solving tasks related to determining a variable set of technical parameters and their variability limits that ensure optimal quality, special workwear for auto repair shop welder-mechanics was chosen, which wears out quickly under labor conditions due to regular spills of acids and oils/fats.

Currently, methods and criteria for the physiological-hygienic assessment of special clothing according to climatic conditions have been developed, and the relationship between material technical parameters and the garment has been established [4-6]. Analysis of materials used in producing oil- and acid-protective clothing [7] showed that the current wide assortment of protective fabrics, while aimed at improving the quality of the designed item, on the other hand, complicates the selection of a specific fabric sample. Furthermore, fabrics with high oil-acid protection properties are expensive, making their use in production for the enterprise almost impractical, and the addition of extra components significantly increases the overall weight of the garment. It is noteworthy that the number of companies worldwide wishing to provide their staff with unique, company-identifying workwear designs is also growing.

RESULTS AND DISCUSSION

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An analysis of existing analogues was conducted to determine the impact of the artistic-constructive solution of the item on the service life of special oil-protective workwear for auto repair shop welder-mechanics [8, 9]. To identify the predominant parameters of fabrics and special clothing constructive-technological solutions, the wear topography of worn-out special workwear for auto mechanics from the "ToshAvtoServis" service center (Fig. 1) was studied based on visual inspection results. Figure 2 shows a scheme of garment wear topography.

The wear topography scheme was developed by analyzing photographs of 100 suits (jacket and trousers), classifying zones into highly soiled, moderately soiled, and relatively soiled areas based on the distribution variance of soiling degree on the garment surface.



Figure 1. Appearance of auto mechanic special workwear after its service life.

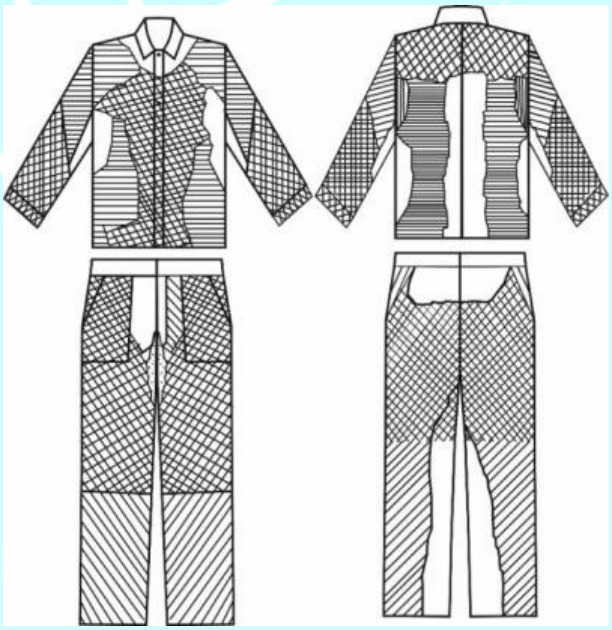


Figure 2. Wear topography of auto mechanic special workwear.

In the process of developing special clothing design, determining the optimal size of the protective element for the cost-effective use of protective materials creates the possibility of predicting the item's service life. We proposed a methodology [9] for assessing the degree of soiling of different parts of special clothing based on changes in the physical-mechanical indicators of the item

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material. This methodology determines the degree of soiling using optical assessment, considering the change (darkening) of the material surface color due to soiling from acids and oil/fat spills. As a result of soiling, oil and dirt particles settle on the fabric surface, altering its structure and color, which is visually perceived as darkening or discoloration of the fabric surface. The degree of darkening and the area of darkening can indicate the level of soiling. The material's color affects the visual perception of soiling: the lighter the material, the more clearly the darkening is detected. Figure 3 shows the process of identifying soiling zones using an Empyrean Panalytical X-ray diffractometer.

The study of the X-ray diffraction of the special clothing structure was conducted on a Malvern Panalytical Empyrean diffractometer. XRD data were recorded using CuKα radiation (λ = 1.54 Å) with a Malvern Panalytical Empyrean analytical diffractometer. In this experiment, the radiation generator's accelerating voltage was set to 45 kV and the current to 40 mA. X-ray diffraction reflexes were recorded in Bragg-Brentano beam geometry at 2θ=5° - 80° with a constant scanning speed of 0.33 degrees/min [10-12].

The system for transforming graphic solutions of clothing models was implemented as an information technology component in a test version within an existing software-methodological complex. Developing the mathematical support for the geometric transformation process of the garment allows for automated transformation of the item's graphic solutions. Figure 5 presents variants of graphic solutions for special clothing sketches on front and back parts, according to the soiling topography. The transformation of clothing constructive-compositional solutions on the selected basic basis allows for expanding the special clothing assortment and efficient use of protective elements. Figure 3 proposes and implements for production several variants of special clothing solutions based on a single basic foundation, rationally using protective material by determining the optimal dimensions of the soiling zone and protection area of special garments at the stage of creating the constructive-decorative and technological solution of the garment according to real operational conditions.

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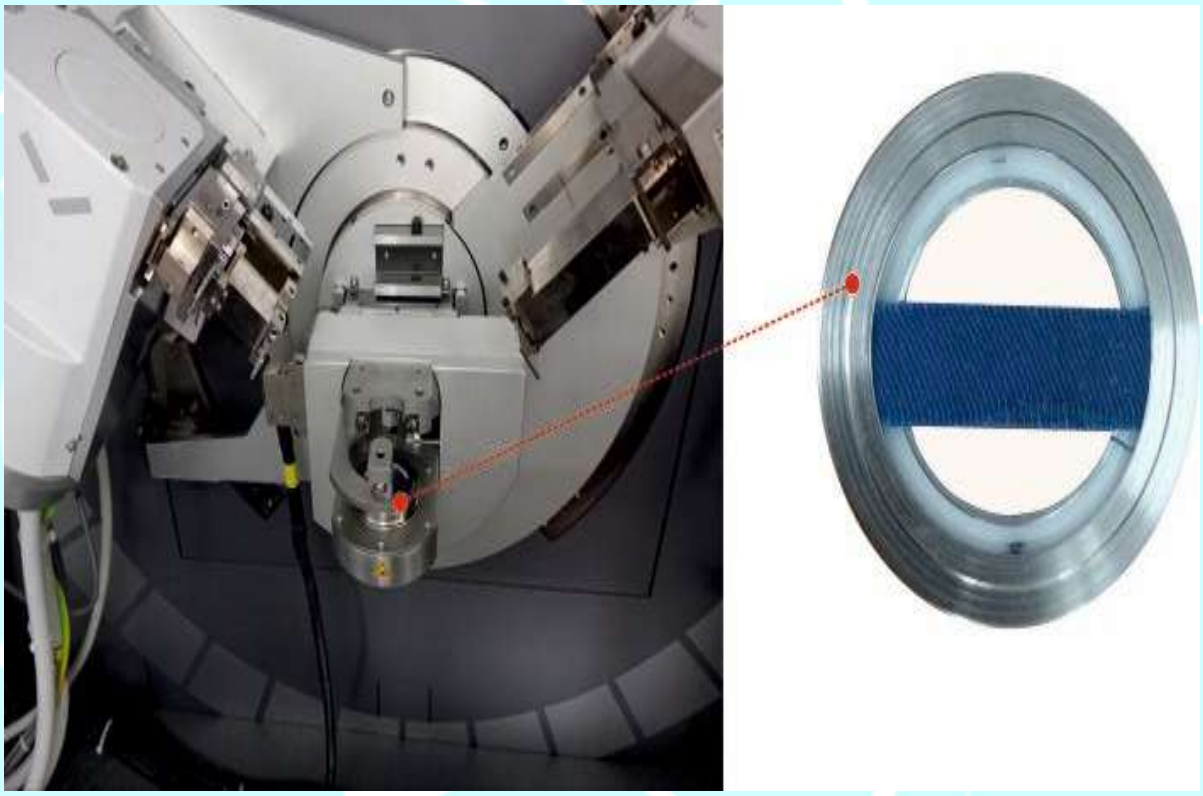


Figure 3. Process of identifying soiling zones using an Empyrean Panalytical X-ray diffractometer.

Considering the labor conditions of workers, the wear topography of special clothing, and parameters from the analysis of existing model analogues, a special clothing model was developed using protective materials, and a prototype was prepared at "Golden Ring" LLC.

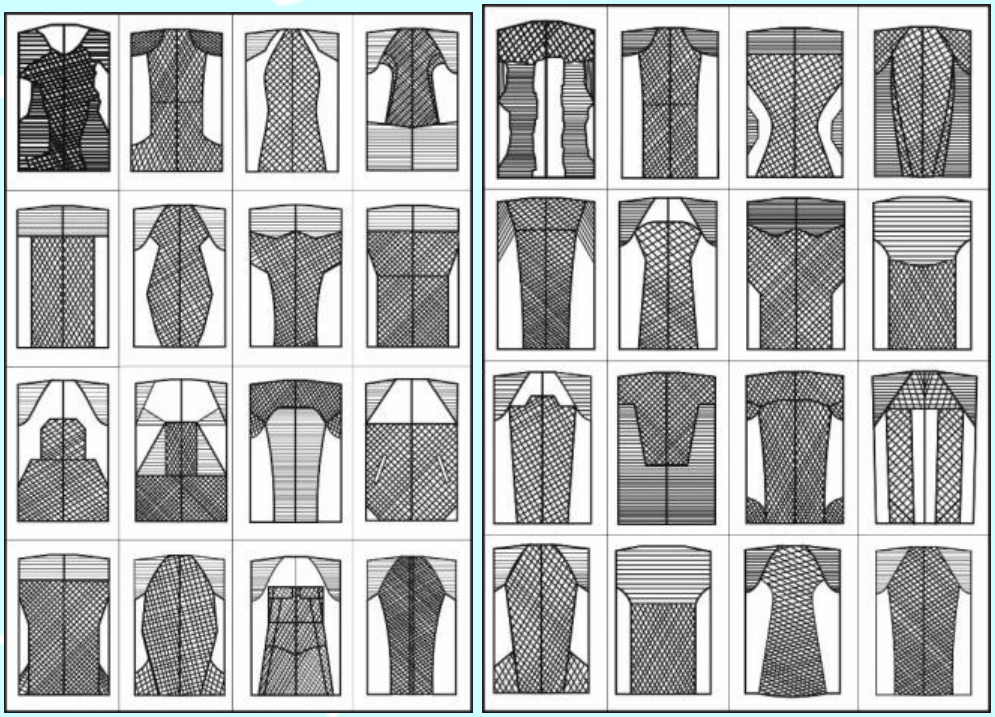


Figure 4. Variants of graphic solutions for special clothing sketches on front and back parts according to soiling topography.

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Figure 5. Samples of special workwear for auto repair shop welder-mechanics developed on a single basic basis with different constructive-compositional solutions.

Thus, methodological support for an information-search process has been developed, which, at the initial design stage, enables the search for graphic solutions for special clothing models based on identifying optimal zones of soiling and wear according to real operational conditions. Tools for assessing the effectiveness of various constructive-technological solutions for forming a special clothing assortment have been developed, allowing for the expansion of functional modules in automated systems. The use of a graphic representation database in the automated design of an industrial workwear collection can significantly reduce design development time and decrease the number of errors caused by the human factor.

CONCLUSION

In designing protective clothing, determining the optimal dimensions of the soiling zone and protection area of special garments at the stage of creating the constructive-decorative and technological solution of the garment according to real operational conditions contributes to the rational use of protective material and extends the service life of special clothing. In forming a special clothing assortment, it allows for assessing the degree of conformity of the protective clothing assortment to the real structure of production-consumer situations and enables decision-making.

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