

УДК: 677. 021.125

EDN: [TEYEHF](https://www.edn.net/TEYEHF)

DOI: <https://doi.org/10.47813/2782-2818-2022-2-2-0310-0317>



## Разработка рационального пакета материалов спецодежды для работников нефтедобычи

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**Аннотация.** Значительные отличия климатических условий пустынных районов Узбекистана от условий других нефтегазодобывающих стран делают актуальной разработку новых видов спецодежды для работников нефтегазовой отрасли. Исследована ткань спецодежды для промышленных рабочих, используемая в швейной промышленности. Учитывая, что из этих тканей изготавливают рабочую одежду, были проведены исследования на соответствие тканей требованиям государственного стандарта. При этом учитываются качественные показатели текстильных тканей из хлопчатобумажных и смесовых тканей. В статье изучались физико-механические свойства каждой текстильной ткани и результаты обобщались в специальной лаборатории на основании нескольких показателей.

**Ключевые слова:** геологоразведка, взрывоопасность, горючесть, условия, пыльная буря, специальная одежда, защитная одежда, общее солнечное излучение, эстетика.

**Для цитирования:** Чориева, М.М., Нигматова, Ф.У., Мансурова, М.А. & Султанова, Ф.У. (2022). Разработка рационального пакета материалов спецодежды для работников нефтедобычи. *Современные инновации, системы и технологии - Modern Innovations, Systems and Technologies*, 2(2), 0501–0508. <https://doi.org/10.47813/2782-2818-2022-2-2-0310-0317>

## Development of a rational package of materials overalls for oil production workers

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**Abstract.** Significant differences in the climatic conditions of the desert regions of Uzbekistan from the conditions of other oil and gas producing countries make it relevant to develop new types of overalls for workers in the oil and gas industry. The fabric of overalls for industrial workers used in the clothing

industry has been studied. Taking into account that working clothes are made from these fabrics, studies were carried out to ensure that the fabrics meet the requirements of the state standard. At the same time, the quality indicators of textile fabrics made of cotton and blended fabrics are taken into account. The article studied the physical and mechanical properties of each textile fabric and the results were summarized in a special laboratory based on several indicators.

**Keywords:** exploration, explosion hazard, flammability, conditions, dust storm, special clothing, crude oil, total solar radiation, operational, aesthetic.

**For citation:** Chorjeva, M., Nigmatova, F., Mansurova, M., & Sultonova, F. (2022). Development of a rational package of materials overalls for oil production workers. *Modern Innovations, Systems and Technologies*, 2(2), 0501–0508. <https://doi.org/10.47813/2782-2818-2022-2-2-0310-0317>

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## INTRODUCTION

The relevance of this work is caused by the need to provide oil and gas production workers with high quality professional clothing, to raise the prestige of professional clothing for oil and gas workers. In the conditions of modern production technologies, special clothing must represent a reliable barrier that provides comprehensive protection and correspond to real operating conditions.

Special clothing is a multidimensional object due to the influence of various hazardous and harmful production factors, among which should be noted the impact of chemical liquids, oils, petroleum products, explosion hazard, flammability, climatic and geographic conditions, mechanical stress, dust storm, etc [1].

To create safe working conditions for workers in the oil industry, personal protective equipment is used, the most common of which is special clothing. Ensuring the safety of workers due to the high quality of overalls and high protective properties of materials, based on the use of new materials with high physical, mechanical and protective properties, is undoubtedly relevant, which is explained by the need to develop levers and incentives to increase the production efficiency of the oil industry [2].

## MATERIALS AND METHODS

The garment bag must retain its protective properties for a long time, as stipulated by the rules for issuing protective clothing. A characteristic feature of the climatic conditions of gas and oil fields in Uzbekistan is their location in the desert, where the summer is very harsh, and hot and dry weather is one of the important criteria in the design of CO for oil and gas workers for production and exploration.

The duration of the hot and transitional periods is up to 9 months. In summer, the average total solar radiation is -17.7 in May; in June -19.4; in July -19.4; in August -18.1 kcal/cm<sup>2</sup>. The duration of the sun's radiance is on average 10 hours, reaching 14 hours a day in summer (June).

High speed winds together with high temperatures and dust storms intensify the heating condition of the environment. The dustiness of the air, which increases with the wind, contributes to the pollution of the body surface, which reduces perspiration due to clogging of the excretory streams of the sweat glands. At the same time, the work of the sebaceous glands is disrupted, the skin becomes dry, less heat-conducting, which causes an additional thermal load on the thermo-rounding apparatus.

In the hot desert climate of Uzbekistan in the summer period ( $t_v = 40-45^{\circ}\text{C}$  during the day,  $t_v = 26-28^{\circ}\text{C}$  at night), the mechanisms of thermoregulation of working oil workers are in excessive stress. Many workers have a decrease in systolic pressure, negative water balance (with a loss of 1-1.5% of body weight), characteristic swelling of the extremities (feet and hands), a sharp decrease in efficiency, constant thirst [3].

The main types of work during the operation of the Bukhara oil fields are carried out in the open air, and the produced oil, its components and various chemical reagents used in the production process are toxic and explosive substances. Taking into account the above, an important condition for the creation of high-quality overalls for workers in oil complexes is - taking into account the physical, mechanical and hygienic requirements for materials for its manufacture.

At the same time, it is necessary to ensure compliance with operational, aesthetic, hygienic requirements and functional comfort of clothing. Such requirements for clothing are aimed at ensuring proper heat, mass and gas exchange of the human body with the environment, the level of body and skin temperature, skin moisture, skin respiration. These requirements can be met by using materials for clothing with rational indicators of such physical and chemical properties as strength, moisture permeability, air permeability, hygroscopicity, on the one hand, and antistatic, windproof, oil and fire resistant properties, etc. Oil protection clothing is regulated by various GOST and TU [4] and international standards [5].

The special clothing used in the fields is a set of cotton costume twill. During operation, a suit made of pure cotton fibers quickly fade under the sun, wears out, breaks, does not provide adequate protection and does not withstand the terms of wear. Protection from rain and oil

products Does not provide special clothing, since by its characteristics it is intended for general purpose CO from industrial pollution.

In recent years, the range of functional fabrics with new protective and hygienic properties has significantly expanded, which creates preconditions for improving the range of workwear. Modern manufacturers of special clothing offer suits made of fabrics that differ significantly from each other in their composition and properties and have a different price category. As an analysis of the modern assortment of special suits for protection against oil, the catalogs of manufacturers of special clothing from different countries with similar climatic conditions were considered.

Uzbekistan. These are the firms "NORDTEX", "Nurafshon-Nur", "Line of protection", "Energocontract", "Sirius", "TECHNOAVIA", "Fakel", "Overalls Legion", "Avangard", "Novaga", etc. which proposed new models of suits for protection against oil and oil products. Various fabrics are used to sew these suits.

Analysis of the materials used in the models of more than two dozen workwear manufacturing companies made it possible to establish the proportional distribution of modern materials for oil-proof clothing, where the main materials used for the top are mixed and cotton fabrics with oil-, water- and oil-oil-water-repellent impregnations. Protective clothing for oil workers must meet a set of requirements that are often incompatible with each other, but ensure a comfortable state of the person (Figure 1).

Oil is mainly composed of 79.5 - 87.5% carbon and 11.0 - 14.5% hydrogen. In addition to the main elements, sulfur, oxygen and nitrogen are present in oil. Small concentrations of the following metals are found in oil: vanadium, nickel, iron, aluminum, copper, magnesium, barium, strontium, manganese, chromium, cobalt, molybdenum, boron, arsenic, potassium, sodium, iodine, zinc, calcium, silver, gallium [7].

The listed elements, settling on the surface of fibers and fabrics, negatively affect the fabric of workwear and adversely affect human health. In addition, oil has the ability to penetrate the porous structures of textile materials, which negatively affects the properties of the materials and shortens the wear period overalls. Therefore, the materials for the manufacture of overalls must be oil-resistant, while the loss of strength from the impact of oil should not exceed 15% [8].



**Figure 1.** Types of overalls for oil and gas workers.

## RESULTS AND DISCUSSION

The research of hygienic and physical-mechanical indicators of modern fabrics in relation to oil-protective overalls has been carried out. The object of the study is blended fabrics made of synthetic and natural fibers, selected as the most frequently used by enterprises - manufacturers of workwear. In total, 14 tissue samples from Chinese and local manufacturers were tested in laboratory conditions. Indicators of the physical and mechanical properties of tissues are presented in table. 1. Cotton and blended fabrics in the weight range from 204 to 253 g/m<sup>2</sup>. All fabrics have high tensile strength (warp from 683 to 1000 N, weft from 500 to 769 N).

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Particular attention should be paid to the indicator of color fastness and abrasion. Practically all prototypes of mixed fabrics have sufficient color strength values of 4 points, which also shows compliance with GOST [1-11209-85].

The analysis of the hygienic indicators of the studied tissues was assessed by air permeability and hygroscopicity. It is known that hygiene indicators depend on the fibrous

composition of the fabric, thickness, surface density of the material, as well as on the design parameters of clothing: the tighter the fit, the less its air permeability [9].

**Table 1.** Results of the experiment of physical and mechanical parameters of fabrics for workwear.

№	Indicators	№ GOST	Sample number							
			№3	№4	№5	№7	№8	№13	№14	
1	Fibrous composition%	25617 ISO 5088	80- Pye, 20- Visc	100- Visc	67- Pye, 33- Visc	67- Pye, 20 – cot, 13- Visc	100- Cot	40- nitron, 60- Visc	40- Pye, 60- Visc	
2	Thickness of fabric, mm		0.45	0.45	0.4	0.35	0.50	0.3	0.48	
3	Surface density, g/m <sup>2</sup>	11209-85	253	248	237	253	254	204	243	
4	Density of the number of threads per 10cm	the foundation ducks	11209-85	360	470	420	430	420	410	440
		11209-85	230	220	230	240	240	230	280	
5	Shrinkage, %	the foundation ducks	11209-85	1.5	2.5	2.5	2	7.5	1	0
		11209-85	1.5	1.5	0	2.5	2.5	0	0	
6	Tensile strength, N	the foundation ducks	11209-85	931	796	993	1000	714	886	1000
		11209-85	628	612	502	736	528	694	769	
7	Breakin elongation, %	the foundation ducks	11209-85	11	14	12	11	12	11	11
		11209-85	19	21	19	17	24	18	18	
8	Color fastness, point									
	Dry friction Wet friction		4 4	4 3	4 3	4 3	4 3	4 3...4	4 4	
9	Abrasion, cycle		25000	25000	25000	25000	21000	25000	25000	
10	Hardness N/m		8.16	1.36	7.1	1.283	1.02	1.35	1.37	
11	Air permeability, cm <sup>3</sup> /cm <sup>2</sup> sec.	11209-85	6.28	5.19	8.26	9.14	32.1	6.28	3.37	
12	Hygroscopicity, %	11209-85	1.22	5.32	3.04	2.43	6.22	1.36	1.47	

Note: some conventional designations are adopted in the table: polyester - Pye, viscose - Visc., Cot - Cotton. abrasion resistance must be at least 7000 cycles. Abrasion resistance of experimental samples - within 21000 - 25000 cycles.

As shown by the research results, the highest values of air permeability have sample №.8 and № 9, and the smallest - №4 from one hundred percent viscose and №14 from polyester and viscose. The hygiene of sample No. 8 is also high - 6.22%. The results presented in Table 1 show that the air permeability and hygiene of fabrics little depend on the fibrous composition and their structural characteristics: with a small value of the coefficient of variation in thickness and surface density of experimental samples of mixed fabrics made of polyester and viscose fibers, the values of air permeability and hygiene differ significantly.

Fabrics made of 100% cotton fiber, with the best hygiene indicators among all the samples under study, have relatively low values of tensile strength (714/528 N) with the requirement of 1000/900 N. Hence, we can draw the following conclusion: when choosing mixed fabrics for overalls for oil workers, the methods of complex assessment should be applied. To enhance ventilation, it is recommended to use ventilation openings, free cut with a constructive increase of at least 8-10 cm [10], which provide a comfortable state of the worker, and the fabrics are treated with protective ones with oil-, water- and oil-oil-water-repellent impregnations. Output significant differences in climatic conditions in the desert regions of Uzbekistan from the conditions of other oil and gas producing countries make the task of developing new types of overalls for workers in the oil and gas industry urgent [11]. A characteristic feature of the desert is a very high daytime air temperature lasting 8 months a year, dusty air, dust storms and sand avalanches, cold winters with a piercing wind.

## CONCLUSIONS

Therefore, when choosing blended fabrics for overalls for oil workers, an integrated approach should be applied. To improve hygienic indicators, it is advisable to improve the design of overalls using materials from cotton raw materials.

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*Статья поступила в редакцию 07.05.2022; одобрена после рецензирования 25.05.2022; принята к публикации 23.06.2022.*

*The article was submitted 07.05.2022; approved after reviewing 25.05.2022; accepted for publication 23.06.2022.*