

**DEVELOPMENT OF SCIENTIFIC REQUIREMENTS
TO SPECIAL OVERALLS FOR MES
FOR REPUBLIC OF KAZAKHSTAN RESCUERS**

**РАЗРАБОТКА НАУЧНО ОБОСНОВАННЫХ ТРЕБОВАНИЙ
К СПЕЦИАЛЬНОЙ ОДЕЖДЕ
ДЛЯ СПАСАТЕЛЕЙ МЧС РЕСПУБЛИКИ КАЗАХСТАН**

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The article discusses the development of scientifically-reasonable requirements for special overalls to identify significant factors according to the results of a questionnaire survey of consumers and expert opinions.

В статье рассматривается разработка научно обоснованных требований к специальной одежде по результатам проведения анкетного опроса потребителей и экспертного опроса мнений специалистов спецодежды для выявления значимых факторов.

Keywords: overalls, questionnaire, expert interviews, Ministry of Emergency Situations of the Republic of Kazakhstan, factors, the importance of indicators.

Ключевые слова: спецодежда, анкетный опрос, экспертный опрос, Министерство чрезвычайных ситуаций Республики Казахстан, факторы, значимость показателей.

The basic requirements for special overalls for rescuers of Ministry of Emergency Situations of the Republic of Kazakhstan (MES RK) which must satisfy: protection

from influences of harmful and dangerous productive factors; providing of labour safety; maintenance of the human's normal functional state his capacity [1].

For determination of the most significant indicators was conducted a survey of the 50 rescuers of Central regional airmobile operative-rescue detachment (Astana city) and district department of Emergency Situations of the Republic of Kazakhstan (Almaty city) with 10...25 year work experience as rescuers.

The questionnaire included 12 questions with several variants of answers to each of that. The results of questionnaire used in the determination of requirements for protective special overalls for rescuers of MES RK.

It was conducted a survey of specialists-experts' opinions about importance of signs which characterize quality of special overalls for rescuers of MES RK.

According to the results of experts' survey was made the matrix of grades. The influence degree of factor on the investigated value is measured by sum of grades: the lower the sum of ranking factors, the more influence it has on the investigated value.

Expert's survey data processed by known methods of mathematical statistics [2].

The degree of consistency of expert's opinions $\chi^2 = 436,32 > \chi_T^2 = 29,82$ at $f=k-1$ significance level.

As a result of the ranking it has been found that the protective overalls for rescuers are: overalls design with a combination of "free" cut; available location of details; stability of the parts connections and aesthetic requirements.

The survey revealed the presence of all the above factors of the impact. The greatest impact on the human body has a mechanical damage (55%) and the fumes and dust content of the working space atmosphere (35%). Effect of mechanical damage due to the following factors: the clearing of debris; dissection of complex structures; working with various types of rescue tools; carrying stretchers with injured by two people on a flat locality and four people along crossed localities; underwater works; extraction of a significant number of injured and dead victims and and others.

One of the basic requirements from survey data was: durability of fabrics for special overalls; quality of clothing manufacturing; presence of additional elements and details and design solution of current overalls [1].

Currently, the fabric used for special overalls clothing - "Classic 180" art. 82039 (3221-h), the fibrous structure – 65% Polyester, 35% of Vis, which does not meet the norms and requirements of consumers. During the exploitation of overalls under the moisture, especially when washing fabrics which treated protective impregnations lose barrier properties. For longer preservation of the protective properties of fabrics is recommended, according to GOST [3] used instead of washing dry cleaning, and the treatment does not cause a large shrinkage of fabric.

The survey showed that 100% of respondents subjected to wash overalls, although provided for dry cleaning. And, of course, special overalls after three or four washings significantly loses its protective properties and shrinks. Frequent washing is the basic factor of wear overalls.

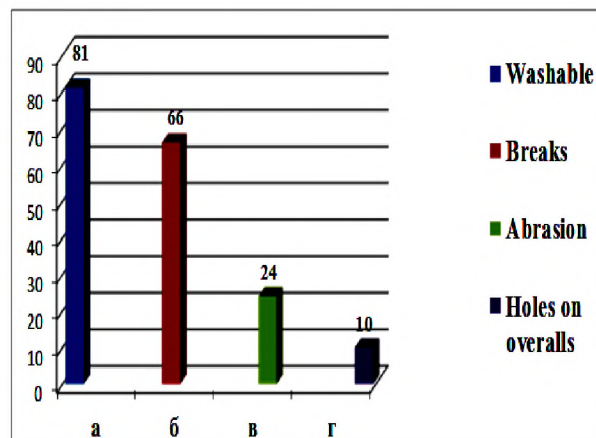


Fig. 1

Abrading influence on the special overalls has a physical nature and type of mechanical manifestations harmful and hazardous working conditions when disturbed fabric structure in contact with various surfaces. Result of action - frayed space and reducing the fabric durability, which leads to a reduction of overalls' protective properties.

Fig. 1 shows diagram of the significance of the main factors of wear overalls.

As can be seen from the diagram the most important factor is "drying". Next in importance - breaks. The least significant to the overalls are factors of "attrition" and "hole in the special overalls".

The importance of indicators completeness special overalls is shown in Fig. 2.

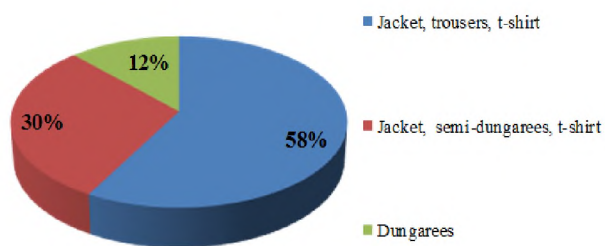


Fig. 2

As seen in Fig. 2, 58% of the experts think that special overalls for MES RK is recommended completeness consists of a jacket, trousers and T-shirts.

Diagram of significance colors for special overalls shown in Fig. 3.

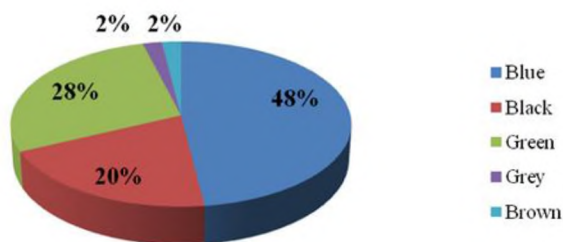


Fig. 3

In fact the most appropriate color solution is blue.

The importance of the use of details in overalls for MES RK is shown in Fig. 4.

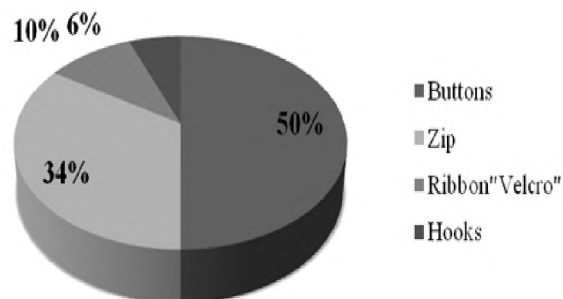


Fig. 4

As seen in figure 4, the most important is the design of the construction with the fastener in the form of buttons and lace-zipper.

CONCLUSIONS

1. It was conducted a questionnaire survey of consumer and special overalls experts opinions as result of which revealed significant factors: durability of fabrics for special overalls; overalls manufacturing quality; the presence of additional elements and details and design solution of current overalls.

2. Data processed by methods of mathematical statistics.

3. It is developed science-based information:

- A set consisting of a jacket, trousers and T-shirt;
- Color solution (blue);
- Recommended accessories details in the form of buttons and lace-zipper.

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**THE STUDY OF THE DURABILITY
OF SPECIAL CLOTHES' TEXTILE MATERIALS TO OIL**

**ИССЛЕДОВАНИЕ СТОЙКОСТИ
ТЕКСТИЛЬНЫХ МАТЕРИАЛОВ СПЕЦОДЕЖДЫ К НЕФТИ**

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The article presents the study of the durability of the special clothes' textile materials to oil. The studies of the protective properties of materials were conducted, which allowed choosing of the optimal fabric vender code 18422 as a/X-M to produce the special clothing which has high oil resistance.

Статья посвящена исследованию стойкости материалов спецодежды к нефти. Проведены исследования защитных свойств материалов, которые позволили выбрать оптимальную ткань арт. 18422 а/Х-М для изготовления спецодежды, обладающей высокой нефтестойкостью.

Keywords: special clothing, textile materials, the durability to the oil, durability, the bursting load.

Ключевые слова: спецодежда, текстильные материалы, стойкость к нефти, прочность, разрывная нагрузка.

In industrial conditions of the petroleum company "Master Munay – Gaz Energo" LLC (city of Aktobe) one of the dangerous and harmful industrial factors to be noted are the petroleum and petroleum products [1].

The petroleum permeability of the textile materials defines the protection level of workers from the aggressive environments' influence. As it known, the petroleum has the property to permeate into porous structures of textile materials, which affects negatively on

materials' property and wear date of special clothing [2], [3].

As the research objects in the present work there were chosen materials having different fibres composition and interweaving, such as: vender code 18422 a/X-M, 81421, 18452, characteristic of which presented in a table 1. The tests on order to define the durability properties of the textile materials to petroleum were conducted according to GOST №29104.12–91 [4].

Table 1

| № | Fabric | Vender Code | Composition of the fibrous fabric, % | Finishing | Interweaving |
|---|-------------------------|-------------|---|--|--------------|
| 1 | Prime - Comfort 250A | 18422 a/X-M | 80 Cotton 20 Polyester + antistatic thread | petroleum moisture-repellent, petroleum petroleum moisture-repellent, Stop Petroleum | Twill |
| 2 | Prime Standard 250 | 81421 | 65Polyester, 35 Cotton | Moisture-repellent, petroleum moisture-repellent, petroleum petroleum moisture-repellent, Acid-50, Acid-80, petroleum shrink, CH | Twill 2/1 |
| 3 | Premier Cotton Rich 230 | 18452 | 60 Cotton, 40 Polyester | Moisture-repellent, petroleum moisture repellent | Twill 2/1 |

In order to conduct the experimental research works, the elementary samples with 40x500mm size were prepared: six on the basis and eight by the weft. To obtain the comparative analysis the bursting load of materials were tested on the bursting machine MT-150/EV, starting with three on the basis and for by the weft before cooling in petroleum, and after three samples on the basis and four by the weft after cooling in petroleum. The bursting load indicators of fabric samples of vender code 18422 a/X-M, 81421, 18452 before cooling in the petroleum is presented on the Fig. 1 (the bursting load indicators of the fabric samples on the basis and by the weft before the cooling in petroleum).

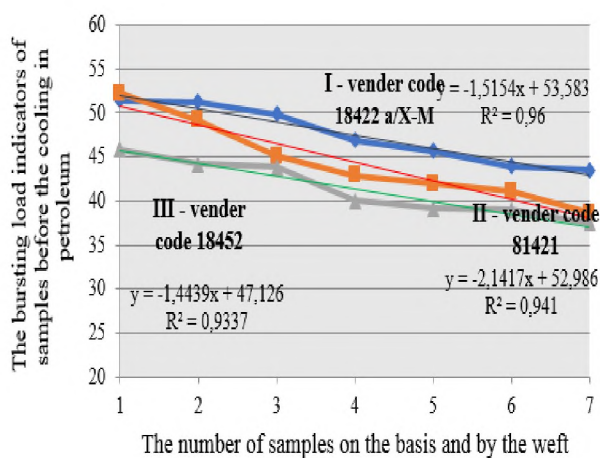


Fig. 1

As seen in the Fig. 1, the bursting load on the basis of the fabric having vender code 18422 a/X-M (I) ranges from 51 to 50 N, and by the weft from 47 to 44 N. The bursting load on the basis of the fabric having vender code 18421 (II) ranges from 52 to 45 N, and by the weft from 43 to 37 N.

The bursting load indicators of samples from fabrics of vender code 18452 (III) before cooling in petroleum is on the basis – 46 – 44 N, by the weft – 40 – 37 N. It should be noted, that the presence of the most percentage content of the polyester fibre and twill interweaving initially provides high indexes of the bursting load to the special clothing fabrics. In our case, the conducted comparative analysis of the materials indicates that most durability kept by fabric with 18422 a/X-M vender code.

Moreover, the work presents the processes of the petroleum permeate into fabrics' structure by the next samples: three samples on the basis and four is the weft. To conduct the research the samples are put in the desiccator with petroleum. In accordance with [4] the samples should be cooled in petroleum for 72 hours, after the washing with petrol for 7 minutes they are to be slightly pressed to removal of the petroleum residue, and then they will be put in between filter paper layers and dried by GOST 10681 in a room temperature.

After conducting the research work described above, the bursting load indicators on the basis and by the weft of the elementary samples were determined. The bursting load of the material samples vender coded as 18422, a/X-M, 81421, 18452 after cooling in petroleum presented in the Fig. 2 (the bursting load indicators of the fabric samples on the basis and by the weft before the cooling in petroleum).

As seen in the Fig. 2, the changes of the bursting load indicators of studied materials after the cooling in petroleum are determined. The bursting load indicators of the fabric samples vender having vender code 18422 a/X-M (I) has decreased for 4%, the vender code 81421 (II) for 9%, and the bursting load indicators of the vender code 18452 (III) has decreased to 13%. Besides, from the obtained equations of the mathematical relationship demonstrated in the Fig. 2, it's necessary to note, that the petroleum penetration character expressed almost identical for fabrics from the chosen assortment.

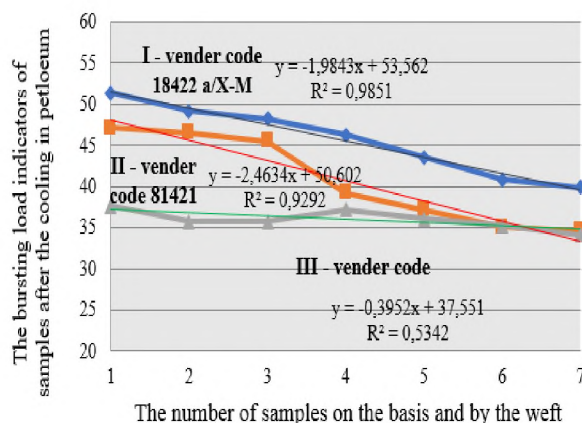


Fig. 2

The fabrics' durability to the petroleum effect on the basis and by the weft is calculated by the next formula:

$$CH_{o(y)} = \frac{P_{p2}}{P_{p1}} 100, \quad (1)$$

where P_{p1} – average arithmetic mean of the bursting load of fabric strip 25×200 mm be-

fore the cooling in petroleum; P_{p2} – average arithmetic mean of the bursting load of fabric strip 25×200 mm after the cooling in petroleum.

The changes of the fabrics' durability to the petroleum effect on the basis and by the weft in percentage are presented in the table 2.

Table 2

| № | Fabrics, vender code. | P_{p1} before cooling in petroleum | P_{p2} after cooling in petroleum | $CH_{o(y)}$, % |
|---|-----------------------|--------------------------------------|-------------------------------------|-----------------|
| 1 | 18422 a/X-M | 47,52 | 45,62 | 96 |
| 2 | 81421 | 44,42 | 40,75 | 91 |
| 3 | 18452 | 41,35 | 35,97 | 87 |

The table 2 shows, that the high durability to petroleum has the fabric with petroleum repelling finishing, vender code 18422 a/X-M (I). The fabric vender coded as 81421 (II) has the second place, has the durability to petroleum of 91%. The 18452 vender coded fabric has a low durability to petroleum, which can premature wear of the special clothing.

CONCLUSIONS

1. On the basis of conducted research works of the materials' durability to petroleum it should be noted, that from fabrics tested, the most durability to petroleum effect has the fabric vender coded as 18422 a/X-M, so far as the fabric content has the antistatic thread and indelible finishing.

2. The approximation ways of the results obtained with help of trend line, which connects two important maximum and minimum points of the bursting load indicators of the materials on the basis and by the weft, before and after cooling in petroleum.

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