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RESEARCH OF PHYSICAL AND MECHANICAL PROPERTIES OF MATERIALS FOR MANUFACTURE OF SPECIAL CLOTHING FOR OIL INDUSTRY WORKERS

ИССЛЕДОВАНИЕ ФИЗИКО-МЕХАНИЧЕСКИХ СВОЙСТВ МАТЕРИАЛОВ ДЛЯ ИЗГОТОВЛЕНИЯ СПЕЦИАЛЬНОЙ ОДЕЖДЫ РАБОЧИХ НЕФТЯНОЙ ОТРАСЛИ

МҰНАЙ САЛАСЫ ЖҰМЫСШАЛАРЫНА АРНАЛҒАН АРНАЙЫ КИІМДІ ДАЙЫНДАУ ҮШІН МАТАЛАРДЫҢ ФИЗИКАЛЫҚ ЖӘНЕ МЕХАНИКАЛЫҚ ҚАСИЕТТЕРІН ЗЕРТТЕУ

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In this paper are presented results of studies for determination of physical and mechanical properties of materials that allows selecting optimal options of fabrics to produce special clothing of oil industry workers. Results of experimental dates are approximated. Equations of mathematical dependence allow forecasting the indicators of physical and mechanical properties of fabrics.

В данной статье представлены результаты исследований по определению физико-механических свойств материалов, позволяющие выбрать оптимальные варианты тканей для изготовления специальной одежды рабочих нефтяной отрасли. Результаты по полученным экспериментальным данным аппроксимированы. Полученные уравнения математической зависимости позволяют прогнозировать показатели физико - механические свойства тканей.

Бұл мақалада мұнай саласы жұмысшыларына арналған арнайы киімді дайындау үшін маталардың оңтайлы нұсқасын таңдауға мүмкіндік беретін маталардың физикалық және механикалық қасиеттерін анықтау бойынша зерттеулер нәтижелері көрсетілген. Алынған эксперименттік мәліметтердің нәтижелері жуықталды. Алынған математикалық тәуелділік теңдеулер маталардың физикалық және механикалық қасиеттерін болжауға мүмкіндік береді.

Key words: special clothing, oil industry, oil industry, fabric, properties, bursting load, durability, breathability.

Ключевые слова: специальная одежда, нефтяная отрасль, ткань, свойства, разрывная нагрузка, износотойкость, воздухопроницаемость.

Негізгі сөздер: арнайы киім, мұнай саласы, мата, қасиеттер, үзілу жүктемесі, төзімділік, ауа өткізгіштік.

Introduction

Kazakhstan has set a goal of economic diversification, where the driving force of such change will be the oil industry [1].

As it is well known [2], Kazakhstan has large amount of oil resources, which allow to manage on social-economical, technological, financial and currency problems in a successfully way.

In recent years, dynamics of oil production in the country do have positive growth [3], which generates a significant increase of the work force in the oil industry.

Protective clothing is used to improve the working place safety, diminishing the action of risk factors, which can be of thermal, chemical, biological, mechanical, physical or electric nature and have direct influence on the life and health of the person who carries out a certain activity [4].

The special clothing, which is used in the oil industry of the Republic of Kazakhstan today, does not meet up-to-date labor conditions of workers, has low protective properties, and when choosing materials for its production, the modern update of textile materials' assortment is not being considered. To solve this problem, in the work there are studied physical and mechanical properties of materials which allows an optimal choosing of the fabric for special clothing production of the oil industry.

Moreover, selecting the material with high physical and mechanical properties is one of the most important factors to consider, when producing a special clothing for oil industry workers [5]. In this paper, the selection of the materials for special clothing of oil industry workers was carried out, basing on study of the workers' labour conditions [6].

Research objects and methods

Research objects are: anti-static, fire-resistant, polyester-cotton fabrics and also fabrics enriched with cotton of "Chaikovski tekstil" company [7, 8, 9], which are characterized in table 1.

For the determination of physical and mechanical properties of fabrics as a means of research, next materials were used: breaking machine MT, DIT-M standard device, MT 160 device. Bursting load, elongation at bursting, strength of the fabric in warp and weft, air permeability, abrasion resistance of the test samples were determined by the existing standard methods: GOST 3813 "The determination method of busting characteristics", GOST 12088 "The air permeability determination method", GOST 18976 "The method of determination of abrasion resistance" in scientific-research laboratory on technology and safety of textile materials in Almaty Technological University. According to obtained data results, there were built mathematical models with help of MS Excel.

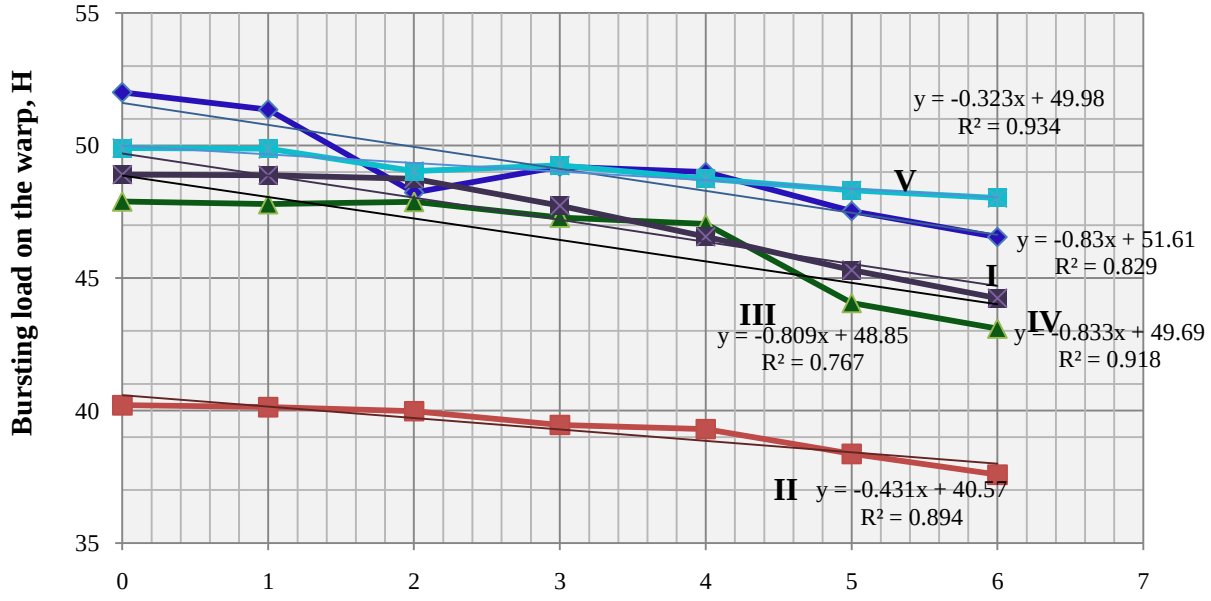
Table 1 – Material characteristics for special clothing of oil industry workers

№	Fabric	Article	The fiber composition of the fabric, %	Finishing	Interlacement
1	Prime Standard 250	81421	65Polyester 35 Cotton	Moisture-repellent, oil moisture-repellent, petroleum oil moisture-repellent,Acid-50, Acid-80, oil shrink, CH	Twill 2/1
2	Prime comfort 250A	18422 a/X-M	80 Cotton 20 Polyester + antistatic thread	oil moisture-repellent, petroleum oil moisture-repellentStopOil	Twill
3	PrimeCotton Rich 230	18452	60Cotton, 40 Polyester	Moisture-repellent, oil moisture repellent	Twill 2/1
4	FlameFort 210A	60405 a-M	100 Aramid + antistatic thread	Petroleum oil moisture-repellent	Twill
5	Prime comfort 250	18422 X	80 Cotton 20 Polyester	Oil moisture-repellent, oil shrink	Twill 3/1

Results and discussions

The data obtained from experiments conducted by authors are shown on figuress 1-6 in the form of diagrams and approximated, i.e. there are equations that describe submitted original dependence. For approximation of data there were used the trend line, which connects two important minimum or maximum points of physic and mechanical properties of the fabric on the graph. The trend line is characterized by veracity of approximation equation and magnitude (R^2). I this paper to build the trend line, it was chosen the linear dependence.

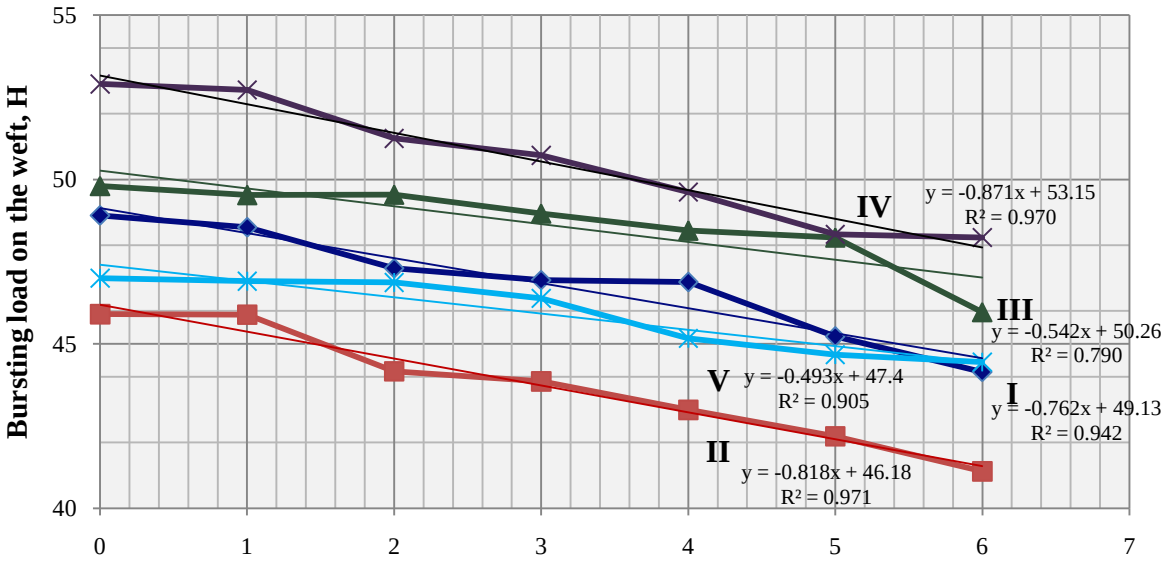
The kinetics of the bursting load's change and of the relative bursting elongation depending from the warp and weft are shown on figures 1-4.



I – article81421; II - article 18422 a/X; III - article 18452;
IV - article. 60405 a-M; V - article18422 X

Figure 1 – Indicators of bursting load changes of the fabric on the warp

As it seen from the figure 1, indicators of bursting load of the fabric on the warp by article 814121 fluctuate from 49 up to 44 H, fabrics of 18422 a/X article fluctuate from 46 to 41 H, fabrics of article 18452 from 50 to 46 H. Bursting load on the warp of the article 60405 a-M is 53-48 H, when fabrics of 18422 X article have 47-44 H. The least magnitude of approximation veracity has the fabric with an article 18452.



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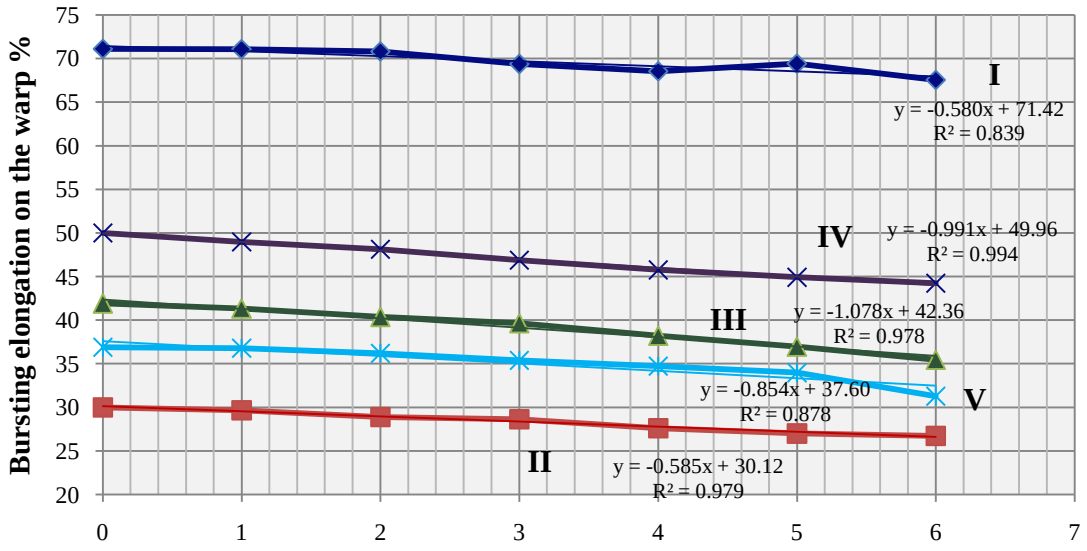
IV - article. 60405 a-M; V - article18422 X

Figure 2 - Indicators of bursting load changes of the fabric on the weft

Figure 2 presents indicators of bursting load on the weft. Same the least value of approximation veracity has fabric of 18452 article.

Figure 3 and 4 demonstrate changes of bursting elongation on the warp and weft.



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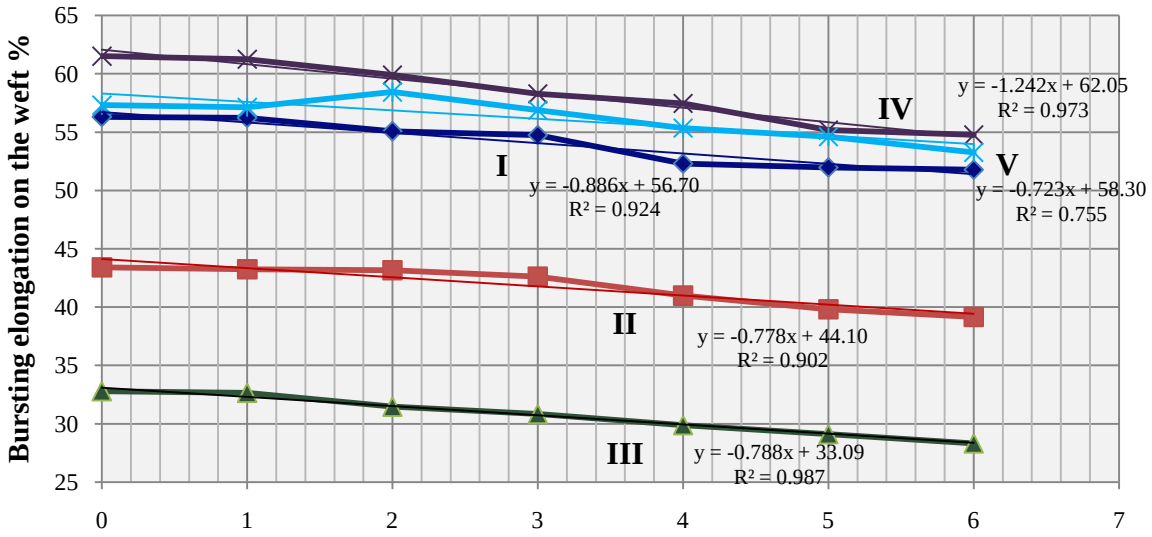
IV - article. 60405 a-M; V - article18422 X

Figure 3 – Indicators of bursting elongation change on the warp



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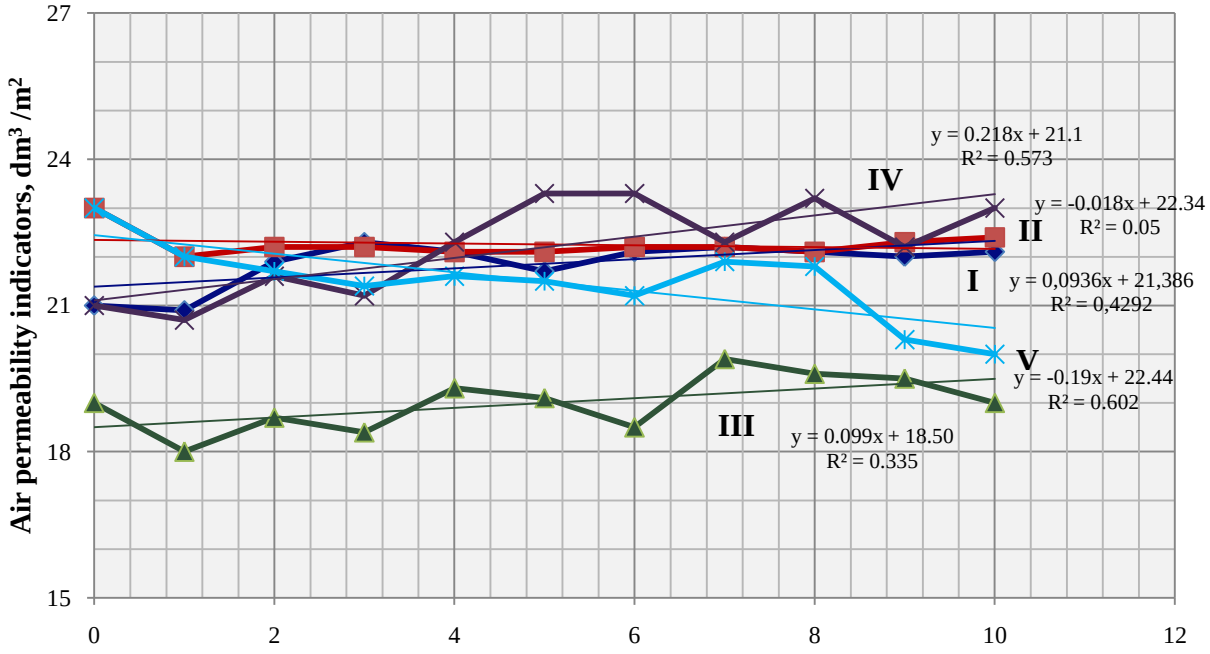
IV - article. 60405 a-M; V - article18422 X

Figure 4 - Indicators of bursting elongation change on the weft

The highest values of bursting elongation changes on the warp has the fabric of 81421 article (fig.3), same on the weft has the fabric of an article 60405 a-M. (fig.4). The leastR^2 rate on the warp has the fabric of 81421 article, same on the weft–fabric of article 18422 X.

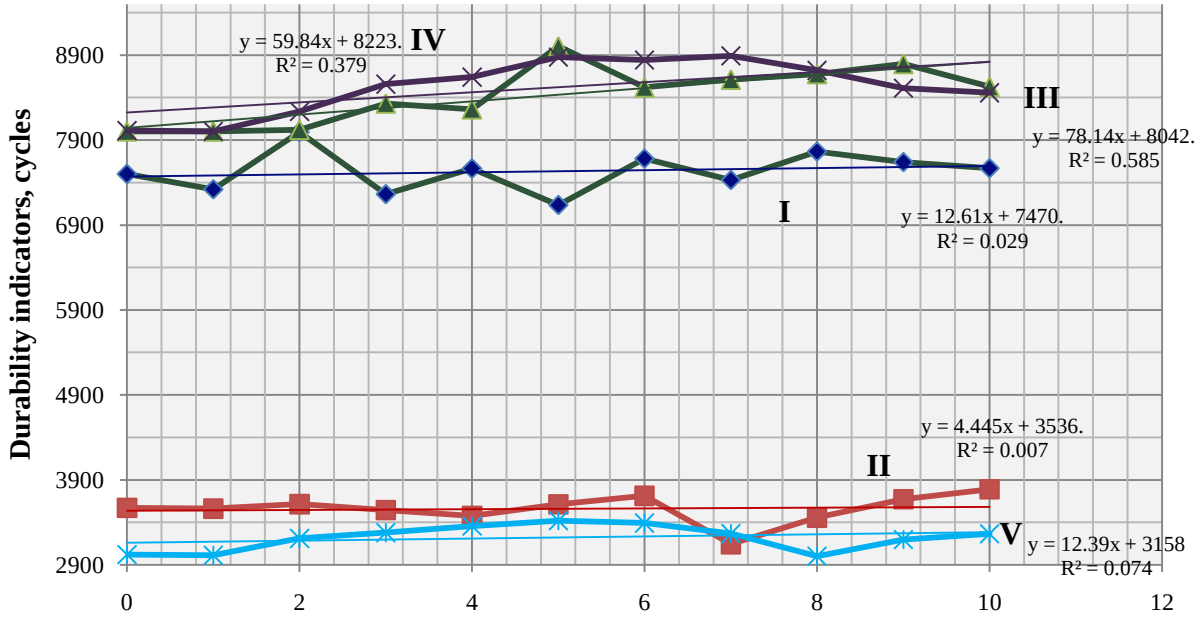
Basing on the results of the research conducted to define the breathability, there was made a graph with breathability indicators (fig.5).



I – article 81421; II - article 18422 a/X; III - article 18452;
IV – article60405 a-M; V - article18422 X

Figure 5 - Air permeability indicators

According to the normative values of physic and mechanical properties of fabrics for special clothing (GOST R 12.2090-2013), the air permeability value must not be less than 20 dm^3/m^2. In this case, the low air permability has the fabric of article 18452. The minimum value of the approximation veracity was determined by fabric of the article 18422A/X.



I – article 81421; II - article 18422 a/X; III - article 18452;
IV - article. 60405 a-M; V - article18422 X

Figure 6 - Durability indicators

Experimental values of durability to abrasion of the fabrics are demonstrated on the Fig. 6 as a graph.

As a result of the research, there were obtained equations of mathematical dependence, in which it's possible to calculate the total bursting degree of the material, depending on the abrasion circle number.

The graph shows, that all fabrics of the chosen assortment have the perfect sustainability to abrasion. According to GOST RF 12.2090-2013 for the special clothing preparing to protect the workers from oil and oil products, the minimum acceptable values of abrasion durability - 2500 cycles. Besides that, all the fabrics have a low value of approximation veracity.

Conclusion

Thus, studies conducted to determine the bursting load, bursting elongation, air permeability, and durability to abrasion of the fabrics do contribute an optimal selecting of the fabrics to special clothing produce for oil industry workers. The obtained mathematical equations of dependence allow forecasting of physic and mechanical properties of the fabrics.

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