Impact Factor:					
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	ISI (Dubai, UAE) = 1.582	РИНЦ (Russia) = 0.126	PIF (India) = 1.940
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	JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

SOI: 1.1/TAS DOI: 10.15863/TAS

International Scientific Journal

Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2021 **Issue:** 06 **Volume:** 98

Published: 19.06.2021 **http://T-Science.org**

QR – Issue QR – Article

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SEARCH FOR A SOLUTION TO THE PROBLEMS OF FORMING A SUIT TO ENSURE COMFORTABLE CONDITIONS FOR THE POPULATION OF THE ARCTIC

Abstract: *In the article, the authors tried to show a way out of the current crisis situation in light industry through a competent assortment and assortment policy within the framework of the advanced development territory with icing up the efforts of all branches of government, namely municipal, regional and federal, as well as in alliance with manufacturers with the support of the Chamber of Commerce and Industry, they will offer consumers of their regions not only demanded and competitive products, but what is especially important - economically justified and guaranteeing enterprises to obtain sustainable TPEs, providing manufacturers with bankruptcy prevention and guaranteeing them stability within the framework of standardization as a tool for managing the production of quality products, and the population of these regions - employment and satisfaction their social problems.*

Key words: *assortment, assortment policy, competence, preference, standardization, production management, product quality, demand, competitiveness, stable financial position, stable TPP, demand, profit.*

Language: *English*

Citation: Blagorodov, A. A., Prokhorov, V. T., & Volkova, G. Y. (2021). Search for a solution to the problems of forming a suit to ensure comfortable conditions for the population of the Arctic. *ISJ Theoretical & Applied Science, 06 (98),* 501-533.

Soi: http://s-o-i.org/1.1/TAS-06-98-60 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2021.06.98.60

Scopus ASCC: *2000.*

Introduction

UDC 685.14: 319.77

Economic science arose and developed in the context of politics, like political economy. Today, economists in politics are guided not by political economy, but by economics in politics. Instead of investing in the development of production, they hide money in foreign banks, cut funding for education and self-education, increase the number of the poor, do not index pensions, refuse to help farmers, etc. "Manilov" nineties were replaced by "buns" of the tenth of the XXI century.

There is no progress without retreats, slowdowns in movement, recessions. The policy is called upon to take active, purposeful actions to help overcome the obstacles arising in development. Politicians must stay ahead of the economic movement and direct it, stimulate domestic economic factors with political levers, and clear economic paths to efficient production. Instead, politicians continue to link development plans to the price of oil, the ruble size of

the European and American currencies, referring to the integration trends in the world and globalization.

The integration of transnational relations is an objective reality, but for all its objectivity, it does not deny the specifics of national economic advancement. Moreover, integration is objectively called upon to contribute to national development. Why can't we do it as it should be? This question arises from a logical comparison of the policy in the field of strengthening defense capabilities, restoring the country's international authority in the most difficult circumstances of the formation of a new world architectonics with the fact that from year to year Russians observe and fully feel on themselves in the sphere of the rest of the economy. two governments? The second one "clicks on the gas and slows down" at the same time.

The protracted recession in the Russian economy can be explained in two ways. First, the people have lost the ability to work well, squandered "human capital", second, the managers are helpless. The media assure that politicians know their business, keep events under control, take the necessary measures and promise changes for the better in the near future. Therefore, the reason is the poor performance of the performers and the unfavorable global environment.

How naive do you need to be to rely on the sincerity, disinterestedness, and sympathy of your competitors when planning your economic policy? The President of the Russian Federation stated long ago that our Western partners do not want to strengthen Russia, they need an obedient Russia, such as the Baltic republics that were formerly part of the USSR. I didn't want to sadden the politicians responsible for the economy, but following Aristotle, we were forced to state: "Friends in the East" are also on their minds - in the sense" Plato is my friend, but the truth is dearer . They will help us as we benefit from such assistance.

It's time to understand that all economic and political alliances in the modern world space are an attempt to achieve national gain in the environment of transnational relations, i.e. you can count on partners as long as this cooperation is beneficial to them. From which the conclusion follows - it is necessary to face your economy. Only in this way, albeit with great effort, will it be possible to solve their problems. For example, there are no objective reasons that would justify the decline in production in light industry for a quarter of a century.

The problems of agriculture and light industry are not specific to them, they have always been political. In the USA and Europe, farmers have a lot of our problems. The difference is that the farmer there is a national problem among the most important and basic ones. Its consideration is relevant for the existence of politicians. From how the policy contributes to the resolution, the public place of the politician is assessed. The farmer and the politician are linked by economic policy. They balance on one tightrope of economic viability.

There is nothing similar in Russia. Let us recall the history of the last ministers of agriculture. In the USSR, there was a Ministry of Light Industry, which emphasized the importance of the industry. What prevents, in the context of import substitution and declarations about the importance of developing our own production, to restore equality in industrial management. A "chintz land" without light industry is the same as native nature without birch groves or lyric poetry without the creativity of S. Yesenin.

The reformers of the 1990s were the least worried about the fate of the Fatherland and the country's industrial identity. They built their business on the ease of maximizing profits and placed the walrus away from the land of their ancestors. Light industry has traditionally been a difficult management problem. Managers must be, first of all, patriots, otherwise light industry cannot be raised. It is also necessary to understand the national importance of "long money". Resilience of demand would compensate for the difficulties.

What is the essence of the ineffectiveness of politics in the economy of the late last century and the beginning of the new century? This is question number 1, and it is not so much about who is to blame. We are interested in the essence of the political paradigm developed by those who were "at the helm". Question number 2 - what should be changed and how, apparently, should it be done in order to raise the national industry, the production of clothing, footwear, leather goods, textiles, accessories, not least?

The answer to question # 1 is simple - no one was going to develop a paradigm of economic policy aimed at a radical transformation of the basis. It was decided to choose the method of reforming (not without outside help) from ready-made samples. It was proposed to take the Swedish experience, the Polish "shock therapy", reforms in Portugal and Argentina as a model. Such innovators, courageous scientists, wise organizers as Gaidar, Chubais, Koch, Burbulis did not come up with the idea with which a responsible owner usually begins - what I have in order to copy something.

Politics is not done depending on the state of feelings - either like or not like the level of everyday perception of the world. It is harmful to be in the "political kitchen" with such an approach. Economic policy does not qualify as "good" or "bad", "effective" or "ineffective". It has the right to be called either "useful" or "harmful". The price of such a policy is too high, and accordingly, the responsibility is not limited to the professional form. Politics is politics. It is anti-political and unprofessional to make politics a source of one's own income.

Whatever the economic situation develops, it is extremely dangerous to make the meaning of

economic criteria in absolute terms, to endow them with the property of universality. F. Engels spoke out sharply against attempts to reduce the teachings of Karl Marx about social development to "economic materialism", "economic determinism." The economic basis is the basis of social organization, but in no way a system-forming factor for its improvement.

The most difficult component of economic reforms is the achievement of social satisfaction with the distribution of the national product. The health of society depends on this satisfaction, and not on the form of ownership. And we have come to an important conclusion - the quality of reforms is assessed not by the changes themselves, but by the ability to impart features of stability to public life.

Integration, globalization is not a panacea for development. They do not cancel the competition, in which there are more than one winner. There are more losers. Hence the relevance of the old truth, the meaning of which became clear in dialectics. Movement in any conditions becomes self-movement. The Chinese closed themselves off rationally and won. The victory was ensured by Eastern caution and skepticism about the unification. They realized before us that integration and globalization are types of "pyramids" and are conditionally useful for national development. From the outside, it might seem that the Chinese reformers have abandoned the curse mentality: "to live for you in times of change." From the inside, everything looked traditional - politicians did not betray with a sharp movement on a national scale, they were in a hurry, but with a constant linking of actions to the state economic order, reforms in the economy subordinated traditional political dominants, did not repent and did not try to please. Nobody seriously thought about any economic shocks. They took finance as the circulatory system of the economic organism into "tight government mittens", introduced toughening for economic and corruption crimes, equating many of them with dangerous actions against the state, did not come up with new parties - they updated the existing one, as before, paid special attention to personnel policy. The Chinese took into account the Soviet party experience of "growing" cadres, which was based on the principle of progressive advancement depending on business efficiency and lifestyle.

Main part

The market for the light industry is also growing due to socio-cultural progress, in particular, thanks to the development of professional sports, an increase in the demand for those who choose sports as a path to a healthy lifestyle. At the end of 2020, the Sport Express newspaper published an interview with the Chairman of the Board of the Russian Outdoor Group A. Grebtsov. “The outdoor market serves mountaineering, tourism, extreme sports, special forces, rescue teams, polar services and troops. These are areas that require heavy-duty, frost-resistant, waterproof equipment that meets the latest world standards of safety and comfort. " A. Grebtsov gave interesting details, in particular, he compared the technological base for the production of quality products in the Russian Federation, Europe and Asia. We are "somewhat behind", according to him, from the Asian potential, but with Europe "We can definitely compete ... in Russia there are about 30 enterprises that know how to sew well." After the introduction of the import ban for state orders and state defense orders, the share of materials from the member countries of the Customs Union supplied to the country's law enforcement agencies increased from 30% in 2017 to 93% in 2020. In 2020, the tendency for an increase in the share of materials produced by the KPEC countries used for the production of clothing should be about 90-95%. The turn of the state order towards domestic production will open up opportunities for the subcontractors of the chemical industry (raw materials for thread, accessories, membranes, insulation). Will increase the production of fabrics, sewing clothes, which will pull the development of equipment. D. Manturov believes that in order to consolidate the achieved results it is important:

- make it clear to large retail chains the importance of purchasing and placing goods produced in Russia, of course, taking into account their proper quality;
- to place, first of all, orders for production from those “who have already got on their feet and know how to sew”. They were able to prove their worth;
- provide assistance to enterprises with obtaining European certification, otherwise foreign companies will not be interested in them, and the goods produced in our country will not get to the West;
- actively support enterprises by providing them with collective stands at international exhibitions;
- provide such enterprises with subsidies for loans for the purchase of raw materials and supplies. The share of these loans in the total volume of lending should be from 50 to 85%;
- to exempt modern imported equipment from import duties and VAT, such as equipment used in sewing shops, is 90% imported;
- introduce preferential leasing.

As you can see, D. Manturov's program systematizes the main and primary steps in the direction of the light industry in order to return it to its former importance. However, Heraclitus was right in saying that you cannot enter the same river twice. The rise of the light industry can be carried out on a new technological, economic and legal basis.

The manufacturer is currently not interested in making a quality product. "Sheepskin is not worth the dressing" - the costs are high, the cost of goods will rise, the real price will be significantly increased by the intermediary and the seller. As a result, the market for such a product "will not digest" and the manufacturer will be stricken with the fatal disease No. 1 according to E. Deming. On a limited - obviously scanty scale for Russia, quality things are guaranteed to be made, manufactured, but the above practice has nothing to do with the situation in production, it is exclusive.

The first experience of control intervention in the production process in order to give it stability and a certain increment can be found in the activities of shops, individual industries, schools of craftsmen. Most of the famous sculptors of the Renaissance tried to work in teams of stonecutters, directly in the places where the material was mined. They were looking in the quarries for the texture needed to create the image. It was then that the joke appeared: it is easy to make a masterpiece - you need to remove all unnecessary, unnecessary, but first you need to find the basis. In the workshops, in the interests of quality, the craftsmen carefully checked the products, observed the work of the apprentices during the manufacturing process, actively introduced the students to the secrets of production, selecting the most capable of them. Despite the fact that each product was individual, made by a master, it underwent internal control, which was also external from the city shop organizations. Subsequently, such work was defined as the rejection phase.

In terms of content, it was much richer, synthetic, more like “sampling” than “culling”. Creativity moved the masters, the masters studied not less than the students. They were looking for paint, primer, base, perfect images, and they were wrong. Creativity spares no one - neither the greats nor the beginners. Everyone, especially the masters, had to work with the stick method. The concept of "marriage" is not as simple as it seems from the outside. The marriage is not always in plain sight, the masters got out of its hidden forms, which manifested themselves over time. "Culling" was not an act, as in mass production, but a technology. Today it is difficult for us to look beyond the achieved horizon in the development of mass production. It is only clear that its "prudent" form is still more a direction of development than a phase. However, the logic of progress, built on continuity, does not exclude a return to some part characteristic of the shop organization. Mass character should not be a brake on creativity. Over time, it will surely reveal its diversity under the common “roof” of multiple results. Therefore, it is necessary to carefully study the production process, which has been improved in the workshop form.

Modern culling as an act of standardization dates back to the last quarter of the 19th century. The experience of S. Colt's factories is recognized as the beginning, it is believed that the idea of "standard quality" was born there. If we evaluate in the system of our version "quality - standard", then this was a subconscious embodiment of Hegel's conclusion about the dialectic of the ascent of cognition from the abstract concept of quality to the concrete concept of the "standard" of product quality.

At S. Colt, the assembly went without preliminary fitting of parts. Specially trained inspectors performed pre-calibration and rejected unconditioned, thereby speeding up the main - assembly part of production. The experience of S. Colt at the beginning of the next century was developed in the automobile production of G. Ford and G. Leland ("Cadillac"). G. Ford, introducing conveyor assembly, removed the control of components from the conveyor, logically considering that such work should be done earlier. As a result, the “input control” of compliance with the standard calibers was replaced by “output control” at the adjacent production, which cleared the main production of defects and made it qualitatively cleaner.

Further, the process of standardization went through the improvement of what had been achieved; theorists F. Taylor, A. Fayol., M. Weber joined it. In alliance with managers, they identified the basic principles of a scientific approach to organizing mass production: a systematic approach to management; personnel management; delegation of responsibility; scientific rationing of labor. The developed production management system went down in history as the Ford-Taylor production system. Having indisputable advantages, the Ford-Taylor system also contained serious defects, which for a long time "dormant" in its potential. The development of production in the new socio-political conditions of the activation of social democratic interests inevitably pushed the Ford-Taylor system into a dead end. This was also facilitated by technological progress, the process of transforming scientific knowledge into a direct productive force. The desire by all means to implement the principle of not allowing defective products to reach the consumer could not help but lead production into a technological, structural crisis.

This was also driven by the lack of a clear understanding of quality and standard in management theory. They were changed instead of being considered in development. The most noticeable and sensitive was the identification of quality and standard in the production of consumer goods, where the concept of product quality reflects the dualistic nature of the product.

A product intended for subjective, more precisely, subjective use by a person or a social group should be of high quality objectively, physically and subjectively, and should satisfy the consumer with its physical quality. It is naive to believe that only by advertising the physical perfection of a product can a

consumer be attracted to it. Such a consumer should be subjectively none. Interest in the physical quality of a product can be formed by demonstrating its capabilities, but in order for interest to form into a need to buy it, this is not enough. The product should captivate the feelings of the buyer, and this is an irrational process, deeply intimate in nature, expressing the individuality of the consumer. Especially if the consumer is attached to a significant assortment, picky and fastidious.

The quality of consumer goods is not reducible to a system of physical parameters, but in their quality it exists as a kind of core. And just as the atom is not limited to the presence of a nucleus, so the quality of such goods is not limited by the system of physical characteristics. On the contrary, the standard is a purely physical phenomenon and requires a clear description in physical units. One should go to the concept of "quality of goods" through the market, and "standard of goods" should be determined in conditions of scientific and technical creativity.

Subconsciously, we came to the differentiation of the concepts of "quality" and "standard" by the end of the first quarter of the 20th century, when they felt the insidiousness of the absolutization of control over the standard conformity of products. In high-tech, complex production, the share of controllers exceeded one third of those employed at the enterprise, which significantly increased the load on the cost of goods. The price has increased, but the quality has not improved according to the price increase. The buyer had to pay for the previous level of guarantees. Quality began to slow down production efficiency. In fact, the tension was between standardization and efficiency. I had to think about how to improve the physical model of the standard - about new materials, original constructive and technological solutions. The standard is a technical image of the quality of the product. And just as the quality of a product, described in words, depends on knowledge and the ability to use them, the standard is determined by the possibilities of technical modeling of the concept of quality. The understanding of quality is evolving, and the technical model of the quality standard is also changing. Thinking has its own language and technical creativity has its own language, designed to serve as a translator from a scientific language into a technical one that is understandable for production. At the same time, the translator must have a good sense of the organizational and technological capabilities of production, so as not to absolutize the meaning of the idealized model. The image of a model is significant when it fits into the image of production, otherwise the above situation will arise. Good intentions will lead the organization of production to a hellish state.

When the desire for the totality of the organization of quality control came into conflict with the total goal of increasing production efficiency and it became clear that the conflict could not be resolved in the same way, V. Schukhert, who worked in the technical control department of the American company Western Electric, proposed to shift the focus of management quality for the organization of the dynamics of the production process. V. Schukhert's innovation was that he looked at production and the quality of production as a movement and in this context understood the main thing as a movement: firstly, the achievement of stability, and secondly, the inevitability of deviation from the direction of movement.

The task of achieving high-quality production acquired a technical form and meaning by V. Schukhert: it is impossible to avoid variations in the parameters of the obtained quality of products; The quality criterion is the stability of production in a static sense, that is, the convergence of variations with the central line. One of the most important factors in solving the problem V. Schukhert called the restructuring of personal interaction - cooperation, team organization. V. Schukhert was the first to approach the interpretation of the standard in terms of mass production, presenting the quality of production and goods as a statistical form that presupposes a certain fluctuation, which is called tolerance. V. Schukhert did not introduce the concept of a statistical model of a standard, but it was necessarily formed on the basis of his innovative ideas. V. Schukhert tried to give quality management a human face. He emphasized the importance of internal, including personal, motivation. But he did not strive to radically change the position of the worker in production. The alienation of the individual remained fundamentally the same, so the motivation was supported mainly by the financial assessment of the activity. Researchers of V. Schukhert's experience clearly overestimated its content, introducing into the characteristics such a reaction of workers as "the joy of getting results"; "Enjoyment of teamwork, recognition of merit by colleagues and management"; "Feeling of importance", etc. It was more adequate to say that V. Schukhert's method forced managers to learn what is called humanitarian knowledge, which guarantees producers effective results of their work at their enterprises. The reformers of the 1990s were the least worried about the fate of the Fatherland and domestic industrial originality. They built their business on the ease of maximizing profits and placed the walrus away from the land of their ancestors. Light industry has traditionally been a difficult management challenge. Managers must be, above all, patriots, otherwise the light industry cannot be raised. It is also necessary to understand the national importance of "long money". Resilience of demand would compensate for the difficulties.

What is the essence of the ineffectiveness of politics in the economy of the late last century and the beginning of the new century? This is question number 1, and it is not so much about who is to blame.

We are interested in the essence of the political paradigm developed by those who were "at the helm". Question number 2 - what should be changed and how, apparently, should it be done in order to raise the national industry, the production of clothing, footwear, leather goods, textiles, accessories, not least?

The answer to question # 1 is simple - no one was going to develop a paradigm of economic policy aimed at a radical transformation of the basis. It was decided to choose the method of reforming (not without outside help) from ready-made samples. It was proposed to take the Swedish experience, the Polish "shock therapy", reforms in Portugal and Argentina as a model. Such innovators, bold scientists, wise organizers as Gaidar, Chubais, Koch, Burbulis did not come up with the idea with which a responsible owner usually begins - what I have in order to copy something.

The most difficult component of economic reforms is the achievement of social satisfaction with the distribution of the national product. The health of society depends on this satisfaction, and not on the form of ownership. And we have come to an important conclusion - the quality of reforms is assessed not by the changes themselves, but by the ability to impart features of stability to public life.

In such conditions, it is time to abandon the abstract political ideals of dem-reformers and to work out a roadmap for the revival of the light industry in the expectation that the crisis emphasizes the relevance of the rationality of brainstorming, as opposed to the “economic schools” in the trend. What kind of "map" is this, based on the historical experience of the 20th century, when all the main events took place:

- the priority should be consistently the interests of national advancement. I would very much like to say about the development, however, it cannot be received on a national scale now;
- the rate on the full support of the light industry, like most areas of investment of public funds (financial, legal, political, humanitarian), contains a risk, however, within acceptable values;
- the creative potential of specialists is still high. He is quite competitive;
- make it clear to large retail chains the importance of purchasing and placing goods produced in Russia, of course, taking into account their proper quality;
- to place, first of all, orders for production from those "who have already got on their feet and know how to sew." They have proven their worth;
- to assist companies in obtaining European certification of materials, otherwise foreign companies will not be interested in them, and the goods produced in our country will not get to the West;
- actively support companies with collective stands at international exhibitions;
- provide such enterprises with subsidies for loans for the purchase of raw materials and supplies. The share of these loans in the total volume of lending should be from 50 to 85%;
- to exempt modern imported equipment from import duties and VAT. The machines used in the sewing shops are 90% imported;
- introduce preferential leasing.

The wise Buddha laid down four key steps in the eightfold path: correct understanding; making the right decision; finding the right words and, finally, the right actions aimed at implementing the right decisions. The fate of the light industry now depends on what this last step will be. Its execution is the function of the Government. The political paradigm is extremely simple - we should not compete with anyone in the fight for the world market, especially with the Chinese. The Chinese rightfully want to shoe and dress the whole world. One fifth of the world's population lives in the PRC. Our task is completely different. We need to make sure that the Chinese do not put shoes or clothe us. To transfer purchasing demand to our own Russian production, to interest in goods produced in the country. We are quite capable of such a task, as the manufacturers say. And the Government needs to do its direct work consistently and in a timely manner, and not deceive the public in the light industry, as happened with the sewing of school clothes.

Shoe companies have never found themselves in such a situation as they are now. All markets are divided into many segments. Specialization has reached such a level that you can still hide from competition only in a small space between two adjacent segments of different markets or the same market.

When creating new enterprises for the production of footwear, the five of these subjects of the Southern Federal District and the North Caucasus Federal District in a competitive environment are not attractive due to the successfully developed footwear production.

As a result of segmentation, it was determined that the population of the two districts is unevenly distributed over the territory. The income of the population is much lower than the average in Russia. When forming the range of footwear, one should also take into account the fact that a large share of the population is rural residents. It is also necessary to take into account the national characteristics of the inhabitants, their traditions. What is the main thing today for the success in the market of many new and long-standing firms, small, medium and large enterprises, many of which were not so long ago small, for numerous commercial structures and joint ventures? This is the ability of the firm to provide the

consumer with footwear of a higher quality than before, and moreover, for the same or less price.

Modern production or, as it is also called, world-class production must meet the following requirements:

– have greater flexibility, the ability to quickly change the range of products. The life cycle of products has become as short as ever, the variety of product assortments is higher, and the seriality of products, the volume of batch of one-time production is less. Hence, production focused on the release of mass, standardized products (strictly corresponding to standards, specifications, technical conditions), unable to constantly adapt to the needs of real, often small groups of consumers, is now doomed to extinction;

– use new forms of control, organization and division of labor, taking into account the more complex production technology;

– rely on comprehensive quality management. Quality requirements not only increased, but also changed the nature of decision-making: it is not enough to produce good products, it is also necessary to think about organizing after-sales services, about providing additional branded services to consumers who are highly individualized in their requests;

– simultaneously improve product quality and reduce costs. If earlier it was possible to offer the consumer a lower quality product at a lower price and, conversely, a high price always corresponded to high quality, today the situation has changed. The higher quality of the product should be provided at the expense of the same lower price.

Now in our country there is a situation where most of the population has a very modest income, and it is she who is a potential buyer of mass-produced footwear.

Solving the problems of style, marketing, advertising will allow domestic footwear of mass production to be demanded by this wide sector of the population of Russia. Small and medium-sized shoe enterprises should provide shoes for a more profitable part of the population, however, as well as highly automated production complexes.

In recent years, the absolute increase in the production of leather footwear has been constantly increasing, the range of footwear is being updated at shoe enterprises, taking into account the demand of the population, the production of model and insulated footwear, footwear with a top made of white leather and genuine patent leather, smart shoes for children is increasing. The transition of the country's economy to market relations led to a sharp deterioration in the situation in the footwear industry in Russia due to a decrease in the effective demand of the population, deepening inflationary processes, a crisis of non-payments, which, in turn, caused an imbalance in production and circulation.

The footwear market is an integral element of economic relations, the main participants of which are, on the one hand, shoe manufacturers, and on the other, consumers. As a product in this market, footwear is one of the most complex groups of non-food products with a very diverse assortment.

Footwear is one of the most important goods produced by the light industry of the Russian Federation and imported from abroad. The degree of satisfaction of consumer demand, the profitability and profitability of organizations depend on the correct determination of the quantity and quality of models produced by shoe enterprises, on the competitiveness of the assortment. The result of the interaction of the constituent parts of the market (demand, supply, prices for shoes) is the ability of the supply to satisfy the demand for products at a specific price to the maximum.

Thus, the importance of the footwear market lies in meeting the needs of the population. Accordingly, the development of the market leads to an increase in the level of security of an individual member of society. Markets are made up of buyers, and buyers differ from each other in a variety of ways: according to their needs, financial and other capabilities, location, buying attitudes and buying habits. When segmenting a market, businesses divide large, heterogeneous markets into smaller (and more homogeneous) segments that can be served more efficiently, according to the specific needs of those segments. For the successful sale of manufactured products, shoe enterprises first of all need to segment the consumer market and determine the target segment of this market.

In a general sense, market segmentation refers to the process of dividing the market into groups of consumers according to predetermined criteria, which allows you to concentrate funds on the most effective. A market segment is a homogeneous set of consumers who react in the same way to a product and the way it is presented.

Target segment (market) - a segment selected as a result of market research for a particular product or service, characterized by minimum costs for means of promoting goods and providing the enterprise with the main share of the result of its activities (profit or other criteria for the purpose of the enterprise entering this market).

Segmentation of the footwear market in the Southern Federal District and the North Caucasus Federal District can be carried out both on the basis of one or with the sequential use of several indicators, clearly presented in the diagram (Figure 1).

Results of segmentation of the analyzed basic footwear marketThe Southern and North Caucasian Federal Districts can be presented in the form of a table of ratings. The segment with the lowest total seats is the most attractive.

Figure 1. - Criteria for segmenting the footwear market in the Southern Federal District and the North Caucasus Federal District

Criteria for segmenting the footwear market in the Southern Federal District and the North Caucasus Federal District				
Subject of segmentation	Segmenting object	Segmentation by size	Segmentation by profitability	Segmentation by the size of the average salary
All enterprises that manufacture or intend to produce footwear in the territories of the South and North Caucasian Federal Districts	Southern and North Caucasian Federal Districts of the Russian Federation	The larger the population of the segment, the more profitable for the enterprise	The higher the profitability of each resident, the greater the chance of purchasing the company's products	The higher the salary of a resident, the more likely he will spend it on shoes

As a result of the analysis of Table 1, two regions and three regions were identified where the highest segmentation of the consumer market is observed from two districts: Krasnodar region - 2.15%, Rostov region - 2.65%, Astrakhan region - 2.7%, Volgograd region - 3 , 25%, Stavropol Territory - 5.4%.

However, when performing segmentation, it is necessary to take into account the goals of the segmentation.

When creating new enterprises for the production of footwear, the five of these subjects of the Southern Federal District and the North Caucasus Federal District in a competitive environment are not attractive due to the successfully developed footwear production.

As a result of segmentation, it was determined that the population of the two districts is unevenly distributed over the territory. The income of the population is much lower than the average in Russia. When forming the range of footwear, one should also take into account the fact that a large share of the population is rural residents. It is also necessary to take into account the national characteristics of the inhabitants, their traditions.

When organizing the sale of manufactured footwear, one should also remember that in the South and North Caucasian federal districts there were and remain so-called "hot spots", which are territories with a crisis in the economic situation and a negative political situation.

Table 2 - Results of segmentation of the consumer market of the Southern Federal District and the North Caucasus Federal District by the method of the sum of places, taking into account the weighting factors

Territorial unit name	Ranking positions			The amount of points,%
	profitability, score × 0.45	the salary, score × 0.30	number, score × 0.25	
Southern Federal District, v. incl.				
Krasnodar region	1.8	0.6	0.25	2.65
Republic of Adygea	3.6	2.1	2.75	8.45
Republic of Kalmykia	4.95	2.4	3.25	10.6
Astrakhan region	0.9	0.3	1.5	2.7
Volgograd region	1.35	0.9	1.0	3.25
Rostov region	0.45	1,2	0.5	2.15
North Caucasian Federal District, incl.				
Republic of North Ossetia - Alania	2.25	3	2	7.25
Kabardino-Balkar Republic	2.7	3.6	1.75	8.05
The Republic of Dagestan	4.5	3.9	1.25	9.65
The Republic of Ingushetia	5.4	1.8	2.5	9,7
Karachay-Cherkess Republic	4.05	3.3	3	10.35
Stavropol region	3.15	1.5	0.75	5.4
Chechen Republic	5.85	2.7	2.25	10.8

Correct definition of quality, consistency and systematic quality management gives the manufacturer a decisive advantage in the competition for the consumer. It would seem that everything is simple, but simplicity is equally brilliant and deceiving. The general plan for solving the problem determines the vector of movement, sets the factorial priorities of the activity - no more.

A product made by man is dual in nature, it combines the natural properties of raw materials and the characteristics brought into it by human labor. The product has a rental value and added value. In this context, it is not value that is important - it serves as a quantitative equivalent of the quality of a product in general, but the result of labor - in the form of a transformation of the natural state of an object. The product of human activity has a natural, basic, level and a superstructure, introduced. Hence the need for a dualistic perception of the quality of the product, which should not be interpreted primitively as a double quality. The quality of the product is one, but the production duality of the product is associated with it.

Such two-sidedness of the quality of the goods misleads those who, having not yet understood the art of dialectical thinking, strive to sort everything out “on the shelves”, forgetting about the structure of which these shelves are parts. The quality of a product is only determined by a natural basis, but it is built artificially.

The quality of the product has several creators. This is a fashion designer, constructor, technologist, manager; their qualifications, experience are measured without problems. Others are also within reach, only their measurement is difficult, especially when it comes to the consumer.

The economic situation affects both producers and consumers, shakes the market on the waves of its uneven movement, and together with purchasing power and perceptions of quality.

Outwardly, determining the quality of a product produced for sale on the market seems to be an impossible task, because for this it is necessary to combine not converging, but (mainly) diverging views. One involuntarily recalls Krylov's Fish, Cancer and Pike, who undertook to drag the cart. In our case, there are even more subjects.

The designer, technologist, manager develop their understanding of the quality of the goods (they can be combined), they are linked by the common interest of the manufacturer. The buyer has a special approach to quality. As a consumer, he is not sure about the integrity of the manufacturer. In addition, the buyer has his own tastes, reasons, conditioned by the real buying opportunity. There are also the interests of the market, which has become an independent subject of the economy. Speculation is legalized and attracts with its potential. By controlling the market, an intermediary - a speculator - is able to form an image of quality in his own interests, in particular, through advertising, giving priorities, etc. Finally, there is the quality of the product itself, expressed in the totality of properties of natural origin and added by the manufacturer. As a result, we came to the "quality square", combining product quality and quality image.

Anything common exists objectively, but only through a single one: at the end of the process, there is always a separate, concrete buyer Pyotr Stepanovich Sidorov and boots, which Pyotr Stepanovich chose from dozens of different ones. They seemed to him the best in quality and price. The sales assistant professionally explained to Petr Stepanovich that there are better quality boots in the same price range, but, being an independent person, he did not change his mind. This is why pre-sale preparation of products and the culture of the seller are important. The last word belongs to the buyer, his perception of the quality of the product. Everything else only plays up to him.

The most serious contradiction, apparently, remains the discrepancy in the images of product quality between the manufacturer and the consumer. The special importance of a different approach to the quality of the manufacturer and the consumer is natural. They are the main subjects of the system of economic relations, they have a common goal - a product. The former make it, the latter consume it, but they have different motives due to their different position in the system and the culture of target perception.

The manufacturer creates the product, but not the product - the ultimate goal of the manufacturer, but the sale of the product. The direct connection between the producer and the consumer is local because it has a negative effect on the producer. The seller blocks the consumer from the manufacturer, and the manufacturer is forced to focus not on the market, but on the market situation, which is most often artificially formed by a speculator and advertising.

Money, perhaps, does not "smell", advertising policy frankly "stinks", it is so far from objectivity and free from professional honor. Being in a state of irresponsibility for information, advertising serves the market clearly and in any form.

The manufacturer, unlike the seller, is responsible for information both by law and by his professional reputation. The seller manipulates the information as he sees fit - the manufacturer is constrained by responsibility, besides, the market often dictates the rules of relations to him.

What is the solution for the manufacturer? There is only one way out - a direct presence in the market and significant investments in education and education of consumers. It is difficult to overcome such a program alone, uniting is absolutely real. The domestic manufacturer has everything it needs to oust the speculator from the retail market. He has professional experience, qualified personnel, scientific and technical support, a certain trust of

buyers returning to the old, pre-reform, priorities, which are actively exploited by unscrupulous manufacturers and to which the authorities shyly close their eyes, which does not want to return to the Soviet experience. Confectioners, meat-makers, wine-makers shamelessly use Soviet brands, replacing them with surrogates. Brands of Vyatka, Orenburg, Ivanovo, some Moscow and Leningrad enterprises are returning to the market. The trend of returning interest is gaining stability. Of course, clothes and shoes are not sausages and vodka or chocolate and confectionery products of natural origin.

Assortment formation - the problem of specific goods, their individual series, determining the relationship between "old" and "new" goods, goods of single and serial production, "high technology" and "conventional" goods, materialized goods and (or) licenses and know-how ". When forming the assortment, problems of prices, quality, guarantees, service arise, whether the manufacturer is going to play the role of a leader in creating fundamentally new types of products or is forced to follow other manufacturers.

The formation of the assortment is preceded by the development of the assortment concept by the enterprise. It is a directed construction of an optimal assortment structure, a product offer, while, on the one hand, the consumer requirements of certain groups (market segments) are taken as a basis, and on the other, the need to ensure the most efficient use of raw materials, technological, financial and other resources by the enterprise from in order to produce products at low costs.

The assortment concept is expressed in the form of a system of indicators characterizing the possibilities of optimal development of the production assortment of a given type of goods. These indicators include: a variety of types and varieties of goods (taking into account the typology of consumers); level and frequency of assortment renewal; the level and ratio of prices for goods of this type, etc.

The assortment formation system includes the following main points:

– determination of current and future needs of buyers, analysis of the ways of using shoes and peculiarities of purchasing behavior in the relevant market;

– assessment of existing competitors' analogues;

– a critical assessment of the products manufactured by the enterprise in the same assortment, but from the point of view of the buyer;

– deciding which products should be added to the assortment, and which ones should be excluded from it due to changes in the level of competitiveness; whether it is necessary to diversify products at the expense of other areas of production of the enterprise that go beyond its established profile;

– consideration of proposals for the creation of new models of footwear, improvement of existing ones;

– development of specifications for new or improved models in accordance with the requirements of buyers;

– examining the possibilities of producing new or improved models, including questions of prices, costs and profitability.

But one thing is true: this is a constant evaluation and revision of the entire range.

In conclusion, I would like to once again draw attention to the fact that all this will become a reality if one main condition is fulfilled, namely, the products of domestic footwear will be produced of high quality and taking into account the interests of this very consumer.

Criteria for a reasonable choice of a package of materials for the production of a suit for servicemen in the Arctic were chosen as the object of the study. At the same time, preferences will be clarified that would guarantee them comfortable conditions in the performance of their official duties.

The environment for a person in clothes and shoes is air, hard soil or snow and water. Individual parts of a person's foot can be in contact with any of these environments. In cold conditions, with a difference between the temperatures of the human body and the environment, there is a continuous heat exchange, the transfer of thermal energy from the human body to the environment. With rapidly changing environmental conditions and physical activity, it is almost impossible to maintain a state of thermal equilibrium. The cooling process of the feet is accompanied by the appearance of various uncomfortable sensations in the wearers.

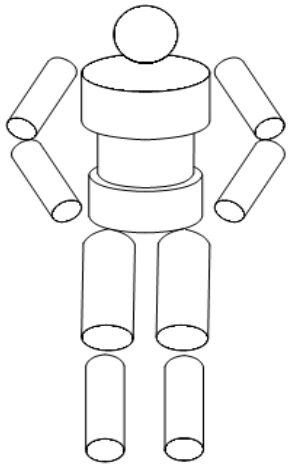
The development of mathematical models of the "man-suit-environment" system, allowing to create algorithms for calculating the initial parameters for personal protective equipment, is an urgent and direct task of mathematical modeling in the development of personal protective equipment for a person in climatic zones with high temperatures.

The figures approximating the human body are considered as systems with distributed or lumped parameters. When the body is approximated by one cylinder, it is possible to speak only about the approximate reproduction of the human thermal regime. A rough approximation is provided by models in which the thermal conductivity, heat production and heat loss of body tissues are taken to be constant throughout the entire thickness of the cylinder or layer. Most authors do not take into account the human physiological thermoregulation system. They consider a person in a comfortable environment, when the thermoregulatory mechanisms are inactive. Our research takes into account the thermoregulation system. Tissue blood flow, metabolic heat production and heat loss by evaporation are considered as functions of average body temperature; brain temperature and average skin temperature;

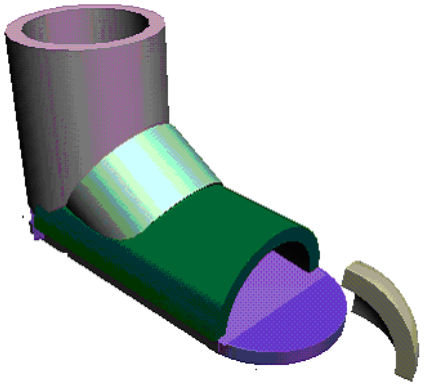
temperature of the brain, skin and heat flux from the skin surface.

Analysis of the existing mathematical models of the thermal state of a person under the influence of environmental parameters makes it possible to presumably determine the shape of the elements of the human body, which can be divided into the following sections: head - ball; arms, legs - cylinders; the torso is a set of elliptical cylinders - that's a rough approximation.

Thus, a person can be represented as a set of geometric shapes shown in Fig. 1a. The concept of mathematical formation of the foot is based on its presentation for shoes as a set of multilayer packages of materials of various shapes and compositions. Using the 3D Studio MAX 5 software, a geometric image of a human foot was constructed (Fig. 1b).



a)



b)

Figure 1 - Geometric image:
***but*- human body, b - human feet**

The main factors affecting the temperature inside the suit space when constructing a mathematical model are the ambient temperature, heat generation of the human body, thermophysical properties of the materials that make up the bags, the shape of these bags and heat transfer from the outer surface of the suit to the environment.

The main criterion for a person's comfortable state is the temperature value inside the suit space in the range from 21 to 25 ° C. At the same time, when a person is exposed to low temperatures, as a rule, perspiration of a person is not taken into account due to its small effect on the heat exchange process. At elevated ambient temperatures, the main role in maintaining a constant body temperature belongs to the skin, through which heat is transferred through radiation, conduction and evaporation. When the ambient temperature coincides with the temperature of the human body, heat transfer is carried out mainly due to perspiration (evaporation of 1 liter of water leads to a heat loss equal to 580 calories). Therefore, with high humidity and high air temperatures, when evaporation of sweat is difficult, overheating of the human body most often occurs. Such cases occur when working in tight, unventilated clothing and, especially, in protective chemical suits. In this regard, it is very important to consider perspiration when designing a suit that provides the necessary time for a comfortable stay in high temperatures.

The indicators characterizing the thermal state of a person include body temperature, skin surface temperature and its topography, heat sensation, the amount of sweat secreted, the state of the cardiovascular system and the level of performance.

Human body temperature characterizes the process of thermoregulation of the body. It depends on the rate of heat loss, which, in turn, depends on the temperature and humidity of the air, the speed of its movement, the presence of thermal radiation and the heat-shielding properties of clothing. Performing work of categories Pb and III is accompanied by an increase in body temperature by 0.3 ... 0.5 ° C. When the body temperature rises by 1 ° C, the state of health begins to deteriorate, lethargy, irritability appear, the pulse and respiration become more frequent, attentiveness decreases, and the likelihood of accidents increases. At a temperature of 39 ° C, a person may faint.

The temperature of the skin of a person who is at rest in comfortable conditions is in the range of 32 ... 34 ° C. With an increase in air temperature, it also grows to 35 ° C, after which sweating occurs, which

limits a further increase in skin temperature, although in some cases (especially with high air humidity) it can reach 36 ... 37 ° C. It was found that when the temperature difference in the central and peripheral areas of the body surface is less than 1.8 ° C, a person feels heat; 3 ... 5 ° C - comfort; more than 6 ° C - cold. As the air temperature rises, the difference between skin temperature in open and closed areas of the body also decreases.

The software product is written using applied mathematical packages MAPLE and is designed to calculate the distribution of temperature and partial pressure in the process of heat and mass transfer in the system "person - clothes - shoes - environment" for a flat package of materials, in the case when a person is in a climatic environment with high temperature.

Let us introduce the following notation:

T_c – ambient temperature (° C);

U_c – partial pressure of moisture vapor in the environment (mm Hg);

t – time (h);

x_i – coordinate i – th layer of the package (m), $l_{i-1} < x_i < l_i$;

$l_{i-1}; l_i$ – boundaries i – th layer of the package;

$\hat{T}_i(x_i;t)$ – temperature i – th layer of the package (° C);

$\hat{U}_i(x_i;t)$ – partial pressure of moisture vapor for i – th layer of the package (mm Hg);

$T_i(x_i;t) = \hat{T}_i(x_i;t) - T_c$ – relative temperature i – th layer of the package (° C);

$U_i(x_i;t) = \hat{U}_i(x_i;t) - U_c$ – relative partial pressure of moisture vapor for i – th layer of the package (mm Hg);

λ_i – coefficient of thermal conductivity i – th layer of the package (W / (m · ° C));

d_i – vapor permeability coefficient i – th layer of the package (kg / (m · h · mm Hg));

$a_{11}(i)$ – thermal diffusivity i – th layer of the package (m2 / h);

$a_{22}(i)$ – vapor diffusion coefficient i – th layer of the package (m2 / h);

$a_{12}(i)$ – diffuse thermal conductivity coefficient i – th layer of the package (m2 / h);

$a_{21}(i)$ – vapor thermal diffusion coefficient i – th layer of the package (m2 / h);

$q(t)$ – heat flux density of the foot (W / m²);

$M(t)$ – the flow density of the mass of moisture released by the human body (kg / (m2 · h));

α – heat transfer coefficient (W / (m² · ° C));

β – mass transfer coefficient (kg / (m2 · h · mm Hg));

The system of equations for describing the process of heat and mass transfer in the system "person - clothes - shoes - environment" has the following form

$$\begin{cases} \dfrac{\partial T_i}{\partial t} = a_{11}(i)\dfrac{\partial^2 T_i}{\partial x_i^2} + a_{12}(i)\dfrac{\partial^2 U_i}{\partial x_i^2}; \\ \dfrac{\partial U_i}{\partial t} = a_{21}(i)\dfrac{\partial^2 T_i}{\partial x_i^2} + a_{22}(i)\dfrac{\partial^2 U_i}{\partial x_i^2}, \end{cases} \quad i = 1,2,\ldots n \ldots (1)$$

The following boundary conditions are considered.

The heat flux of the human body entering the inner surface of the suit is equal to $q(t)$

$$\lambda_1 \frac{\partial T_1}{\partial x_1}(0,t) + q(t) = 0; \qquad (2)$$

The flow density of the mass of moisture released by the human body is equal to $M(t)$

$$d_1 \frac{\partial U_1}{\partial x_1}(0,t) + M(t) = 0; \qquad (3)$$

Heat transfer on the surface of the suit occurs according to Newton's law

$$\lambda_n \frac{\partial T_n}{\partial x_n}(l_n,t) + \alpha T_n(l_n,t) = 0; \qquad (4)$$

The sole of the suit is waterproof, which is expressed on its inner surface by the equality:

$$\frac{\partial U_n}{\partial x_n}(l_{n-1},t) = 0; \qquad (5)$$

ideal contact is assumed between the layers of the bottom of the shoe, which is expressed by the mating conditions at the joints:

$$T_{i-1}(l_{i-1},t) = T_i(l_{i-1},t), \qquad (6)$$

$$\lambda_{i-1}\frac{\partial T_{i-1}}{\partial x_{i-1}}(l_{i-1},t) = \lambda_i \frac{\partial T_i}{\partial x_i}(l_{i-1},t), \; i = 2,\ldots n, \qquad (7)$$

$$U_{i-1}(l_{i-1},t) = U_i(l_{i-1},t), \qquad (8)$$

$$d_{i-1}\frac{\partial U_{i-1}}{\partial x_{i-1}}(l_{i-1},t) = d_i \frac{\partial U_i}{\partial x_i}(l_{i-1},t), \; i = 2,\ldots n-2 \ldots (9)$$

Initial conditions:

$$T_i(x_i,0) = f_i(x_i) \ldots \qquad (10)$$

$$U_i(x_i,0) = g_i(x_i) \; i = 1,2,\ldots n \ldots \qquad (11)$$

As an example, consider the theoretical calculation of heat and mass transfer through the sole of a shoe at an elevated ambient temperature of 40 ° C. The characteristics of the package of materials for the bottom of the shoes are shown in table 3.

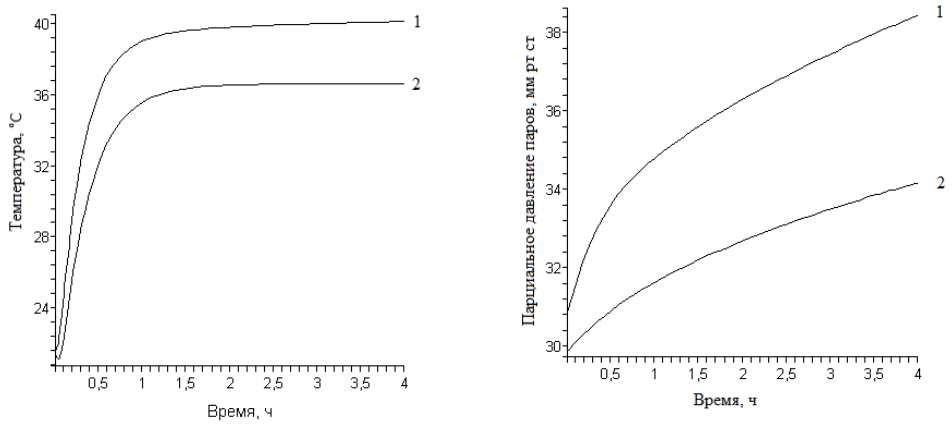
Table 3 - Characteristics of the package of materials for the bottom of the shoe

Layer no.	Layer material	Layer thickness (mm)
1	Cotton sock	2
2	insole	5
3	cardboard	1.8
4	sole	10

The heat flux density of the foot is 10 W / m2, the density of the mass of moisture emitted by the foot is 0.02 ((kg / (m2 which curve 1 - for bags of materials for the bottom of the shoes used as a sole non-porous waterproof rubber; and curve 2 - for a package of materials for the bottom of the shoes, when as the sole was used a material made by nanotechnology and having the ability to ventilate, i.e. to air exchange in the shoe space.

Thus, the development of a software product for the formation of comfortable conditions for a person when he is in a climatic environment with an elevated temperature will for the first time make it possible to make a reasonable choice of a package of materials for a suit in order to realize these very conditions of comfort and significantly improve working conditions for a person in extreme conditions.

If the software for justifying the choice of packages of materials for clothing and footwear in the formation of comfortable conditions for a person who is in climatic zones with a low temperature is due to the control over a decrease in temperature inside the suit space to 21 ° C for the foot and up to 31 ° C for the human body, which were are incorporated in the developed software with a reasonable choice of a package of materials taking into account thermophysical characteristics, then when developing software for a reasonable choice of packages of materials for a person in climatic zones with elevated temperatures, the problem was solved differently, namely, based on the need to control the body temperature.



a *b*

Fig. 2. Characteristics of the shoe space:
***but*- temperature**
***b* - partial vapor pressure**

This is due to the fact that an increase of 0.3-0.5 C0 already forms a person's discomfort, and with an increase over 1 C0, this excludes his being in these conditions. Consequently, packages of materials and a suit made of them must guarantee a person the fulfillment of these requirements during the entire time he is in these conditions.

The software developed by the authors solves this problem and creates the preconditions for a reasonable choice of a package of materials based on the obtained thermophysical characteristics on the stands and devices described in communication 2. Hence, the availability of modern means for determining thermophysical characteristics and packages of materials and the developed software guarantees manufacturers with a high degree of reliability to make a suit that creates comfortable conditions, during the entire time they perform their official duties. The entire list of works offered to the reader should not mislead him, that there is no longer the need for experienced wear. Of course not. Experienced wearing in real conditions confirms the

validity of the conclusions drawn or rejects them. But the availability of highly efficient methods for studying the thermophysical properties of materials and software for a reasonable choice of packages of materials significantly reduces the cost of developing and producing overalls for military workers both for conditions with low temperatures and for conditions with low temperatures. But what is also very important, the formation of requirements for materials, if possible, for their use for the production of workwear is also in demand by the developers of the materials themselves, including with the use of nanotechnology, and this all together will solve the problem of protecting servicemen from the effects of external negative conditions.

Criteria for a reasonable choice of a package of materials for the production of a suit for servicemen in the Arctic were chosen as the object of the study. At the same time, preferences will be clarified that would guarantee them comfortable conditions in the performance of their official duties.

When choosing packages of materials for the study, we took into account the physical and mechanical, thermophysical characteristics of materials, information about the specifics of the operation of this clothing, which were obtained by us from open literature sources.

A feature of a reasonable choice of packages of materials for a suit for servicemen in the Arctic is the fact that they must provide him not only with a comfortable state due to a guaranteed temperature regime under the clothing space of at least 340 ° C, but also meet all the requirements for the manufacture of heat-protective clothing.

For the study, packages of both imported polymeric materials for the production of jackets and packages of domestic polymeric materials were considered, which were evaluated for their satisfaction with the requirements for heat-protective clothing when military personnel are in climatic zones with temperatures of -200C, -30C and -400C. The results of earlier studies using a software product developed by the authors for a reasonable choice of a package of materials in the manufacture of a suit for servicemen in the Arctic showed that at the initial weighted average surface temperature of a soldier of + 360C for all packages of materials using both domestic polymer materials and imported polymer materials, a sharp drop in body temperature is observed at an air temperature of -200C, -30C and -400C, provoking a feeling of discomfort within the first hour of their stay in these conditions, which involves the search for new materials that would guarantee them a comfortable state for at least two hours. Table 4 shows the characteristics of the package of imported polymer materials for the production of jackets, and Table 5 shows the characteristics of the package of domestic polymer materials.

Table 4 - Characteristics of a package of imported polymeric materials for the production of a jacket

Model	Package materials	Thickness, mm	Coefficient of thermal conductivity λ, W / m · ºC
1	2	3	4
Model 1	Synthetic fabric (100% PE)	1.6	0.042
	Insulation Promaloft (main)	12.0	0.034
	Gasket materials:		
	1. TKPM “Picardy” 1242 \ 17	1,2	0.041
	2. TKPM “Kufner” R171G57	1,3	0.031
	3. TKPM "Kufner" B141N77	2.1	0.021
	4. TKPM AKR-622 \ AKR218	3.5	0.009
	Lining fabric	0.76	0.039
Model 2	Synthetic fabric (100% PE)	1.6	0.042
	Insulation "Hollofan" 2 layers basic	12.0	0.036
	Gasket materials:		
	1. TKPM "Picardy" 1242 \ 17	1,2	0.041
	2. TKPM "Kufner" R171G57	1,3	0.031
	3. TKPM "Kufner" B141N77	2.1	0.021
	3. TKPM AKR-622 \ AKR218	3.5	0.009
	Lining fabric	0.76	0.039
Model	Synthetic fabric (100% PE)	1.6	0.042

	Insulation "Kombisherst" "250 + 150" basic Gasket materials: 1. TKPM "Picardy" 1242 \ 17 2. TKPM "Kufner" R171G57 3. TKPM "Kufner" B141N77 3. TKPM AKR-622 \ AKR218	12.0 1,2 1,3 2.1 3.5	0.33 0.041 0.031 0.021 0.009
	Lining fabric	0.76	0.039

The packages of materials were selected in accordance with the requirements for thermal protective clothing and the materials used for its manufacture. When compiling the packages, the purpose of each layer and the thermophysical characteristics of the materials were taken into account. Domestic hot-melt cushioning materials (TKPM), the characteristics of which are given in Tables 4 and 5, will find the greatest application in the manufacture of a suit for servicemen in the Arctic.

Table 5 shows the characteristics of a package of domestic polymeric materials for the production of jackets.

When forming a package, each material must meet the requirements for the manufacture of heat-protective clothing.

The difficulty in compiling the package was the lack of information on a number of materials. Therefore, packages of materials for models No. 1-No. 3 are made up of the most famous imported materials, and packages No. 1 - No. 3 are made up of materials of domestic production.

Table 5 - Characteristics of a package of domestic polymeric materials for the production of a jacket.

Model	Package materials	Thickness, mm	Coefficient of thermal conductivity λ, W / m ºC
1	2	3	4
Model 1	Membrane fabric	3.5	0.06
	Sintepon (100% PE) basic Gasket materials: 1. TKPM "Picardy" 1242 \ 17 2. TKPM "Kufner" R171G57 3. TKPM "Kufner" B141N77 4. TKPM AKR-622 \ AKR218	15 1,2 1,3 2.1 3.5	0.035 0.041 0.031 0.021 0.009
	Fleece	1,2	0.039
Model 2	PE fabric (art. 06617-kv)	2.1	0.040
	Insulation Termofinn Micro basic Gasket materials: 1. TKPM "Picardy" 1242 \ 17 2. TKPM "Kufner" R171G57 3. TKPM "Kufner" B141N77 4. TKPM AKR-622 \ AKR218	15 1,2 1,3 2.1 3.5	0.036 0.041 0.031 0.021 0.009
	Viscose complex lining fabric	0.6	0.044
Model 3	Blended fabric (67% PE + 33% CL)	1.8	0.041
	Wool stitched fabric 2 layers (80% PE + 20% wool) main Gasket materials: 1. TKPM "Picardy" 1242 \ 17 2. TKPM "Kufner" R171G57 3. TKPM "Kufner" B141N77 4. TKPM AKR-622 \ AKR218	20 1,2 1,3 2.1 3.5	0.038 0.041 0.031 0.021 0.009
	Lining fabric art. 32013	0.69	0.049

The difficulty in choosing a package of materials also lies in the fact that when choosing the materials used for a specific product, it is necessary to take into account the region in which these products will be operated, since specific products will be subjected to

different operating conditions in relation to climatic zones. This is especially true of thermal protective clothing used in the Arctic.

Let us repeat and name the main criteria for the comfort of clothes: the temperature of the skin, which should not be lower than 33.3 ° C, and the temperature of the underwear space should not be lower than 34 ° C, that is, the microclimate of the underwear space is an indicator of its comfort, including when exposed to low temperatures. It is not indifferent for a person which part of the body cools more while maintaining the total heat transfer, for example, strong cooling of the legs cannot be fully compensated by heating another part of the body without disturbing the person's sense of comfort. Therefore, it was so important to develop a mathematical model to justify the choice of a package of materials in order to create comfort for a serviceman, taking into account the duration of exposure to low temperatures.

The concept of the mathematical model is based on the representation of clothing as a set of multilayer packages of materials of various shapes and compositions.

To calculate the temperature distribution, the authors used the Maple mathematical packages.

The solution to the problem was reduced to finding such a combination of materials for the package, which would realize a minimum of heat flux from its surface while limiting the volume of the package. Thus, it can be concluded that using the proposed mathematical model, it is possible to optimize the choice of materials for the manufacture of a thermal protective suit.

Consider the temperature distribution problem T_i $i-$th layer in the details of the suit, which is a cylindrical multilayer surface. The ambient temperature is kept constant, equal to T_0 ... A heat flux of density comes from the body to the inner surface of the garment q ... On the outer surface of the garment, heat exchange with the environment takes place according to Newton's law with the heat transfer coefficient α.

Let us introduce the following notation for the basic criteria:

t - time; $T_i(r,t)$ - temperature i-th layer; λ_i - coefficient of thermal conductivity i-th layer; α_i - coefficient of thermal diffusivity i-th layer; R_{i-1}, R_i - inner and outer radii i-th layer; $i = 1,2\ldots n.$

Now consider $n-$layered hollow cylinder and boundary value problem

$$\frac{\partial T_i}{\partial t} = a_i \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T_i}{\partial r}\right), \quad R_{i-1} < r < R_i, i = 1,2\ldots n. \quad (12)$$

With boundary conditions:

$$\lambda_1 \frac{\partial T_1}{\partial r}(R_0,t) + q = 0;$$

$$\lambda_n \frac{\partial T_n}{\partial r}(R_n,t) + \alpha(T_n(R_n,t) - T_0) = 0; \quad (13)$$

Ideal contact is assumed between the layers:

$$T_{i-1}(R_{i-1},t) = T_i(R_{i-1},t);$$

$$\lambda_{i-1}\frac{\partial T_{i-1}}{\partial r}(R_{i-1},t) = \lambda_i \frac{\partial T_i}{\partial r}(R_{i-1},t), \; i = 2,..,n. \quad (14)$$

Initial conditions

$$T_i(r,0) = \varphi_i(r), \quad i = 1,..,n. \quad (15)$$

Solving the problem, it is possible to find the temperature distribution in the layers of the suit and, in particular, the change in the temperature of the underwear space depending on time.

The passage of heat through a multilayer spherical wall is described by a system of heat conduction equations:

$$\frac{\partial T_i(r_i,t)}{\partial t} = a_i \frac{1}{r_i}\frac{\partial^2 (r_i T_i(r_i,t))}{\partial r_i^2}, \quad (16)$$

$R_{i-1} \le r_i \le R_i$, Where R_{i-1}, R_i – inner and outer radii $i-$th layer,

$t-$time, a_i-thermal diffusivity $i-$th layer, $(i = 1,\ldots,n)$.

The heat flux of density arrives on the inner surface of the spherical segment from the foot q:

$$\lambda_1 \frac{\partial T_1}{\partial r_1}(R_0,t) + q = 0. \quad (17)$$

On the outer surface of the body, heat exchange with the environment occurs according to Newton's law with the heat transfer coefficient α:

$$\lambda_n \frac{\partial T_n}{\partial r_n}(R_n,t) + \alpha(T_n(R_n,t) - T_c) = 0. \quad (18)$$

We will assume that there is an ideal contact between the layers, which is expressed by the following relations:

$$T_{i-1}(R_{i-1},t) = T_i(R_{i-1},t),$$
$$\lambda_{i-1}\frac{\partial T_{i-1}}{\partial r_{i-1}}(R_{i-1},t) = \lambda_i \frac{\partial T_i}{\partial r_i}(R_{i-1},t), \quad (19)$$

$i = 2,\ldots,n.$ At the initial moment of time, the temperature of the telp is set

$$T_i(r_i,0) = \varphi_i(r_i), \; i = 1,\ldots,n \ldots \quad (20)$$

Thus, the process of heat passage through the spherical segment from the body to the outer surface is described by the boundary value problem with the initial conditions given above.

When calculating, we took into account the following criteria:

- the thickness of the layers of materials in the package;
- coefficient of thermal conductivity and thermal diffusivity of package materials;
- the density of the heat flux coming from the body;
- ambient temperature;

- the initial temperature of the package of materials;
- coefficient of heat transfer from the outer surface of the package to the environment;
- the presence of an additional layer in the form of heat-protective underwear and a woolen sweater.

When calculating, it was also taken into account that a person has guaranteed thermal protection of legs, arms and head, that is, he is dressed in accordance with climatic conditions.

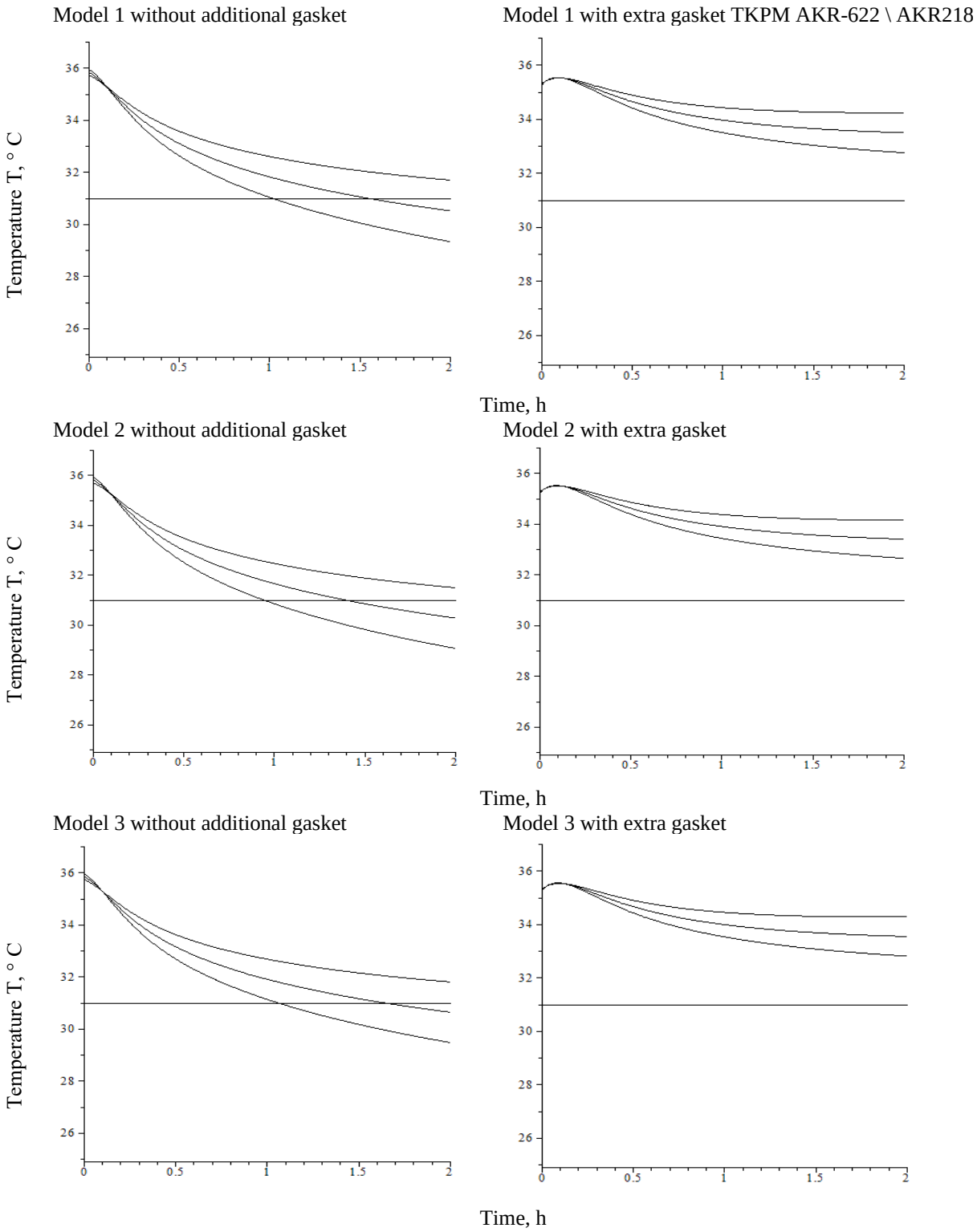
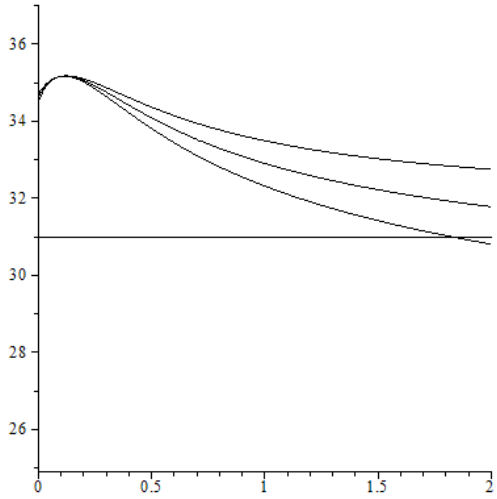
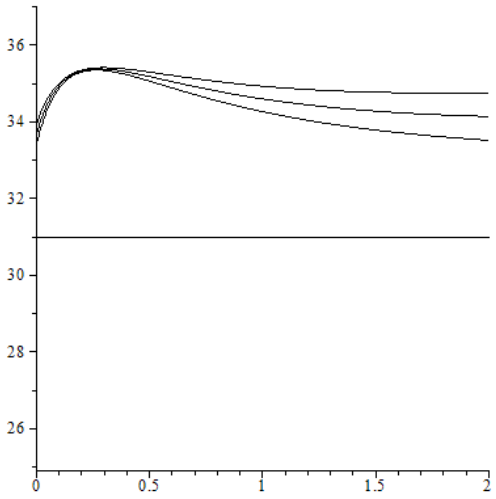


Figure 3 - The results of calculating the weighted average skin temperature for bags consisting of imported materials at ambient temperatures: curve 1 -20 ° C, curve 2 - 30 ° C, curve 3 - 40 ° C.

Model 1 * without additional gasket

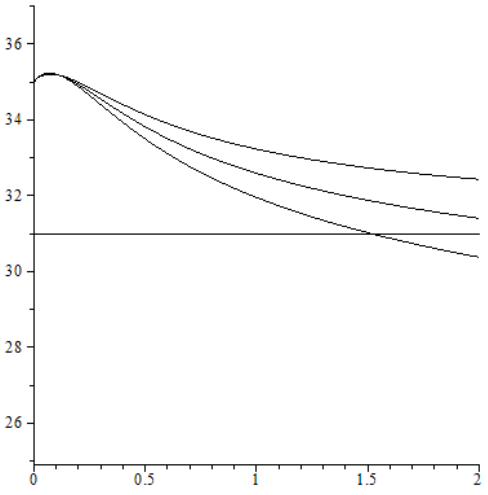


Model 1 with extra gasket

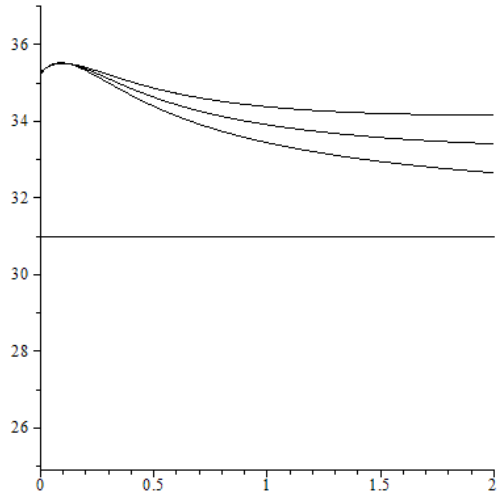


Time, h

Model 2 * without additional gasket

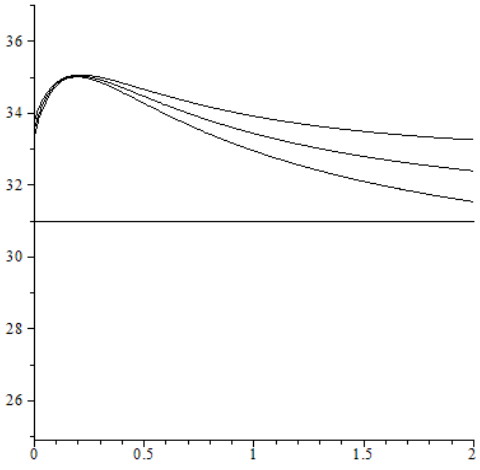


Model 2 with extra gasket

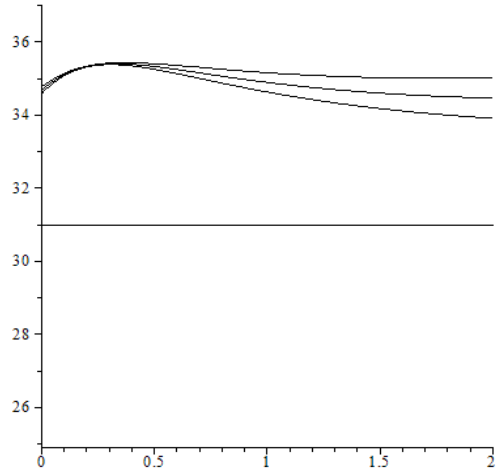


Time, h

Model 3 * without additional gasket



Model 3 with extra gasket



Time, h

Figure 4 - The results of calculations of the weighted average skin temperature for bags consisting of domestically produced materials at ambient temperatures: curve 1 -20 ° C, curve 2 - 30 ° C, curve 3 - 40 ° C.

The calculation results are presented in Figure 3 for imported materials and in Figure 4 for domestically produced materials. These figures show the dependence of the weighted average temperature of the human body on the time spent at low temperatures (-20 ° C; -30 ° C; -40 ° C). The figures show that at the initial weighted average skin temperature of + 36 ° C for all packages of materials, there is a sharp drop in body temperature at an air temperature of -20 ° C, -30 ° C, -40 ° C.

Analysis of the research results confirmed the justification of using TKPM as cushioning materials in the manufacture of a suit for servicemen of the Arctic, since with all TKPM, the comfort of a serviceman is provided for 2 hours of his stay in climatic zones with an ambient temperature of -20 ° C and -30 ° C, but comfortable conditions when it is in the climatic zone at -40 ° C is provided only with the use of TKPM AKR-622 / AKR218, the thermal conductivity coefficient of which is the smallest, namely λ = 0.009W / m · ° C.

- it has been proven that the main criterion for the comfort of a suit of servicemen in the Arctic when they are in different climatic zones is the coefficient of thermal conductivity;
- the possibility of using the software product to justify the choice of material packages for the suit of the Arctic military personnel in various climatic zones was confirmed;
- a high coincidence of the calculated values of heat loss from the surface of the tested jackets with experimental data was achieved, which confirms the legitimacy of using the software product developed by the authors for a reasonable choice of material packages for a suit of Arctic military personnel located in different climatic zones;
- it has been proven that the use of domestic nanomaterials and nanotechnology as linings for a suit for servicemen in the Arctic during the period of the need for import substitution due to sanctions, has confirmed their high quality and efficiency, which makes it possible to expand research and their production with the presence of basic criteria that form a comfortable state within two hours in any climatic zone.

If for shoes and clothes the software developed by the authors allows formulating requirements for a package of materials and ensuring a comfortable state of servicemen for the performance of their official duties, then for the face, hand, big toe, they guarantee comfortable conditions without additional research on the selection of packages of materials for now. fails.

The characteristics of materials for gloves, the use of which would be justified, is given in table 6.

The analysis of foreign experience showed that the so-called mitts are used together with gloves.

There are different types of mitts: ordinary mitts without fingers; mitts with a clip-on mitten; "Pipes" without compartments for fingers and palms.

The peculiarities of the choice of materials for gloves for servicemen in the Arctic are provoked by the climatic conditions of this zone in order to guarantee him comfortable conditions during the entire period of use or his military duties. At the same time, special attention was paid to ensuring the comfort not only of the soldier's hand, but especially the index finger of the right, if he is right-handed, and of the left hand, of course, if he is left-handed. This need is dictated by the specifics of the performance by the military personnel of their duties, namely, to carry out shooting, in which a more intensive cooling of the index finger is provoked.

The use of mitts provides the serviceman with additional protection for the hand, and, most importantly, for the index finger, while the main protection is provided by the glove, and here the authors test not only different wool, but also yarn, forming it from one or double thread.

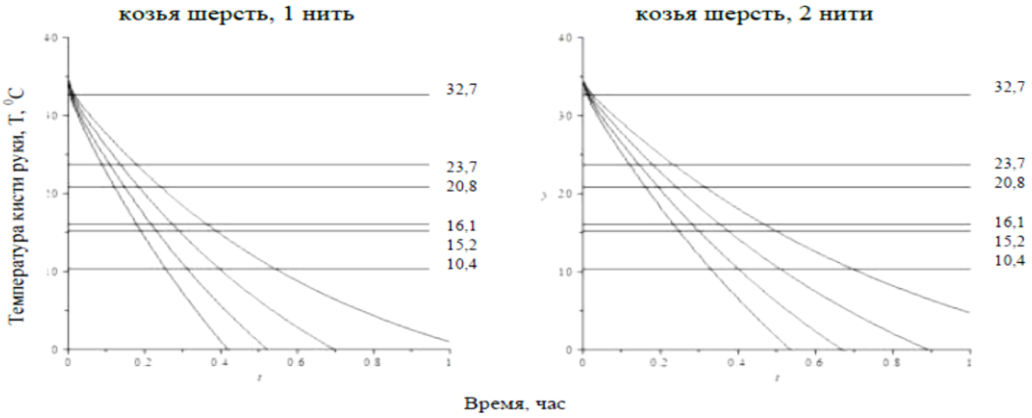
Possibilities of using nanomaterials capable of thermoregulation and providing the skin of the hand with a comfortable temperature, namely, not lower than 32 ° C. Such studies are possible using the same software that the authors developed and used for materials, the characteristics of which are shown in Table 6.

Table 6 - Characteristics of materials in the manufacture of gloves for military personnel in the Arctic

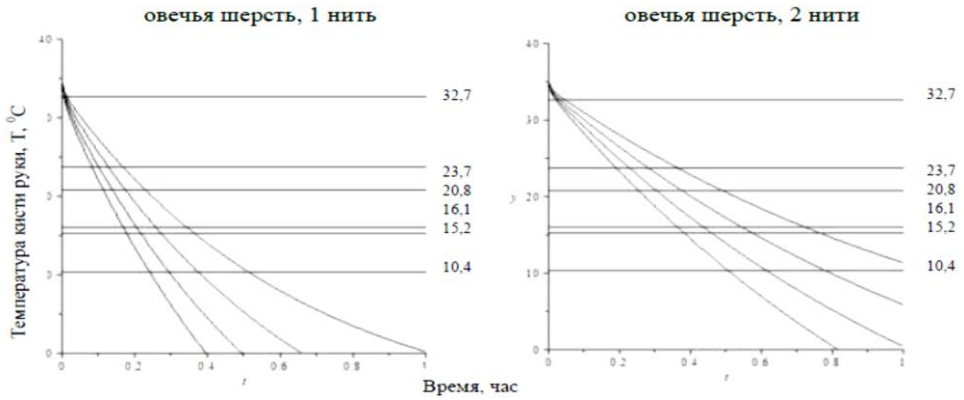
Materials used to make gloves	Thickness mm	Coefficient of thermal conductivity, λ, W / m ° C
1 Single strand yarn:		
1.1 From goat hair	0.7	0.015
1.2 Sheep wool	0.8	0.020
1.3 Camel	0.9	0.005
1.4 From dog hair	0.8	0.010
2. Two-strand yarn:		
2.1 From goat hair	1.4	0.015
2.2 Sheep wool	1.6	0.020
2.3 Camel	1.8	0.005

2.4 From dog hair	1.6	0.010
3. A package of materials for the index finger of the hand, suede + yarn from one strand		
3.1 when using goat hair	1.7	0.02 / 0.015
3.2 when using sheep's wool	1.8	0.02 / 0.020
3.3 when using camel hair	1.9	0.02 / 0.005
3.4 when using dog hair	1.8	0.02 / 0.010
4. A package of materials for the index finger of the hand, suede + yarn of two strands		
4.1 when using goat hair	2.4	0.02 / 0.015
4.2 when using sheep's wool	2.6	0.02 / 0.020
4.3 when using camel hair	2.8	0.02 / 0.005
4.4 when using dog hair	2.6	0.02 / 0.010
5 Material for the fingertip of the index finger of the soldier's hand - "natural suede leather" and for mitts	0.8	0.020

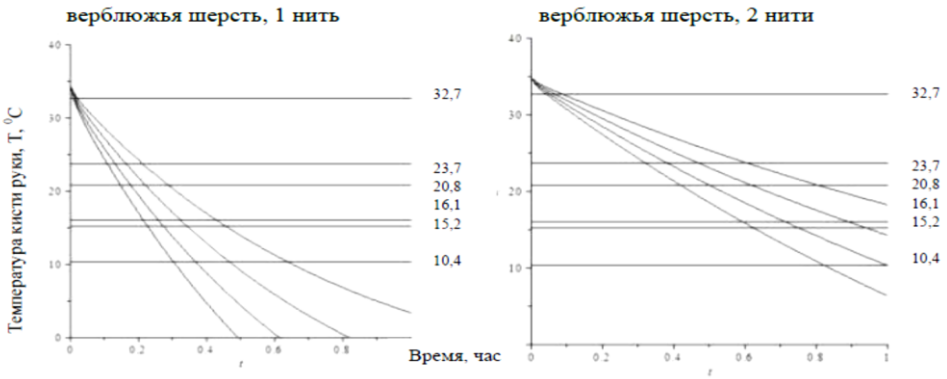
With the help of the software developed by the authors, graphs were constructed characterizing the condition of the skin of a soldier's hand for four ambient temperatures, namely: - 100C, -200C, -300C, -400C from the time he spent at the post, but not less than 1 hour. The figures show the temperature values of the skin of the hand, characterizing the various heat sensations of a serviceman, namely, comfort 32.7 ° C, slightly cool 23.7 ° C, cool 20.8 ° C, cold 16.1 ° C, very cold 15.2 ° C, pain 10.4 ° C (frostbite). At -10 ° C, a comfortable state is provided only by a suede-dog hair package (double thread), and for -20 ° C, -30 ° C, - 40 ° C, none of the materials under study and their packages together with natural fur "winter" do not guarantee comfortable conditions for servicemen.



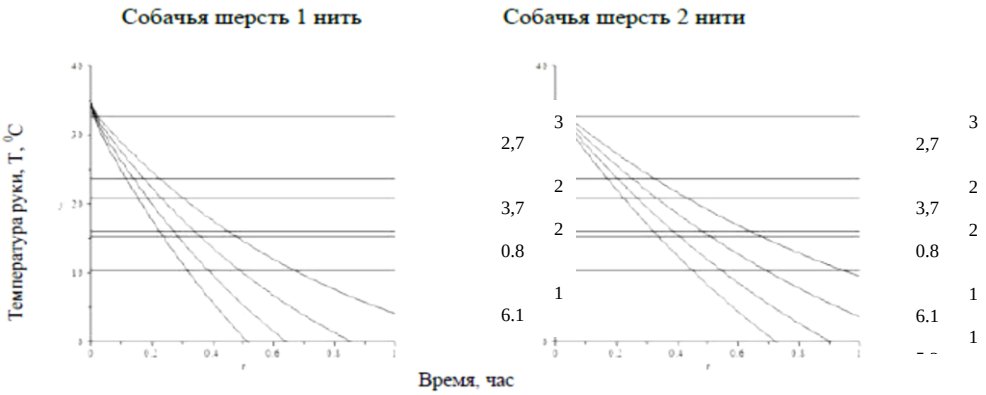
a) Change in the temperature of the skin of the hand when using goat wool yarn from 1 strand and 2 strands for gloves



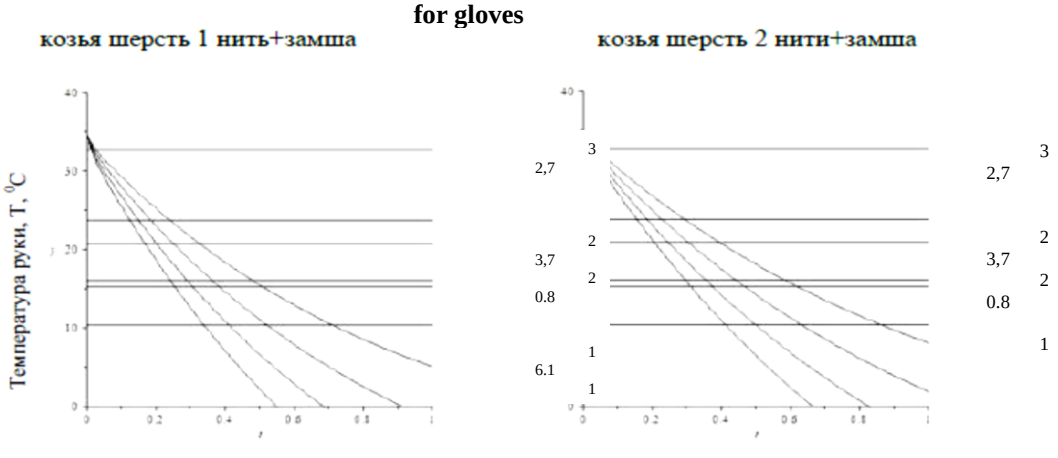
b) Change in the temperature of the skin of the hand when using sheep wool yarn from 1 thread and 2 threads for gloves



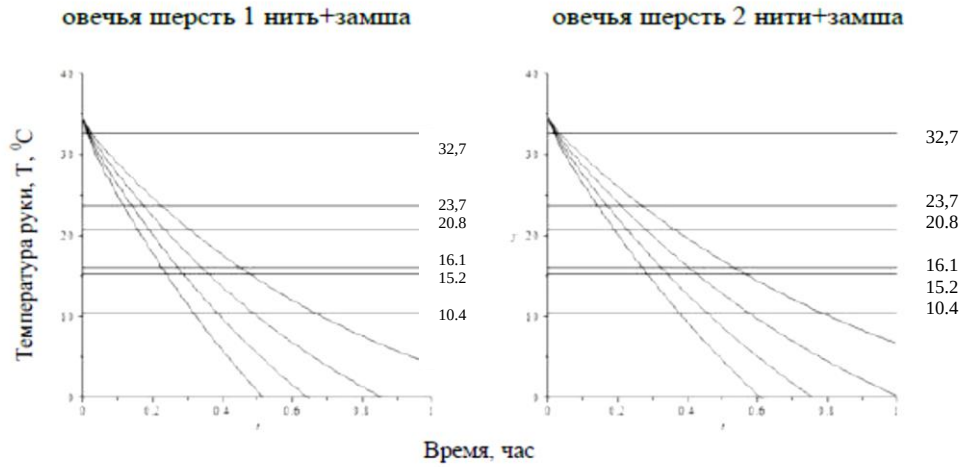
c) Change in the temperature of the skin of the hand when using camel wool yarn from 1 strand and 2 strands for gloves



d) Change in the temperature of the skin of the hand when using dog wool yarn from 1 strand and 2 strands for gloves



e) Change in the temperature of the skin of the hand when using goat wool yarn from 1 thread + suede and 2 threads + suede for gloves



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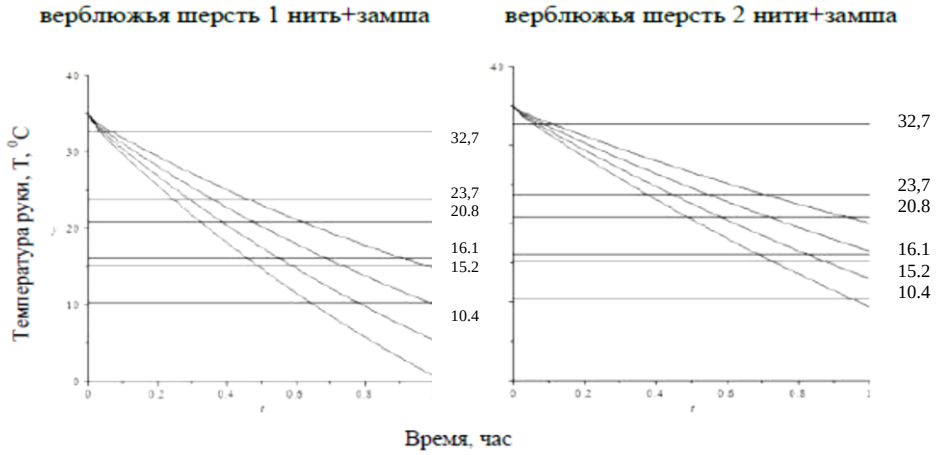
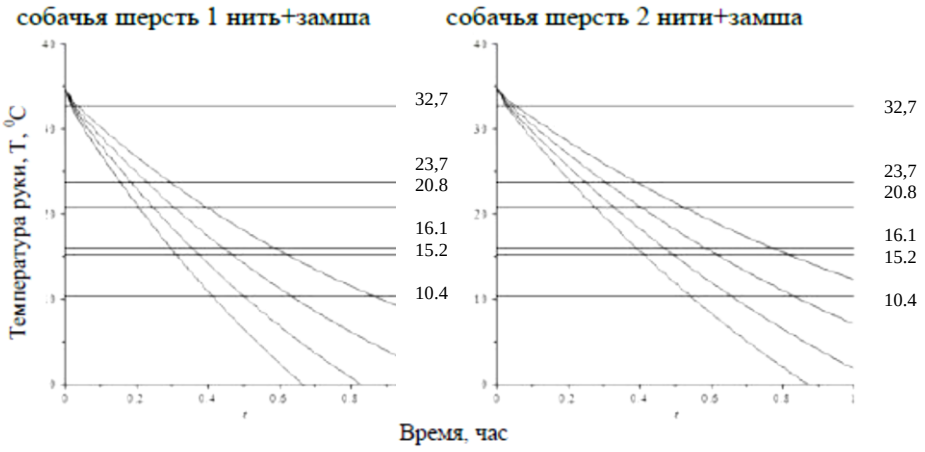


g) Change in the temperature of the skin of the hand when using camel wool yarn from 1 thread + suede and 2 threads + suede for gloves



h) Change in the temperature of the skin of the hand when using dog wool yarn from 1 thread + suede and 2 threads + suede for gloves

Figure 5 - Characteristics of the state of comfort of the hand (skin) of a serviceman when he is in various climatic conditions: curve 1 - at -10 ° C, curve 2 - at -20 ° C, curve 3 - at -30 ° C, curve 4 - at -40 ° C

Consequently, the results obtained substantiated the high efficiency of using the software for a reasonable selection of packages of materials for gloves and other sets of suits for Arctic servicemen and confirmed the need to continue research on the selection of such materials that would provide them with a comfortable state in a given temperature regime for at least one hour.

For the packages and materials shown in Table 7, curves are plotted characterizing the state of comfort of the serviceman's hand for the following ambient temperatures, namely, curve 1 at -10 ° C, curve 2 at -20 ° C, curve 3 at - 30 ° C, curve 4 - at -40 ° C (Figure 5).

The software developed by the authors allows the manufacturer to have a tool for making an informed decision on the choice of packages of materials for the suit of the Arctic military personnel, including in the production of gloves to protect the hand from the effects of low temperatures in the performance of their statutory duties.

Confirmation of these conclusions is the analysis of the properties of the most effective from the point of view of comfortable conditions of the skin of the hand, carried out by the authors, providing a constant temperature within 32.5 ° C.

Unfortunately, gloves made from wool yarns of various animals, made from both one and two threads, do not guarantee servicemen such a comfortable state even at a temperature of -10 ° C, not to mention that the air temperature may be lower. In this case, the surface of the skin of the hand is cooled below the critical value, i.e. below 10.4 ° C and can lead to frostbite and irreversible processes.

The use of mitts to protect the hand also does not guarantee servicemen protection from the effects of low temperatures, suggesting the search for such materials and the formation of bags from them for the manufacture of gloves that would provide them with comfortable conditions, which is possible when using nanomaterials capable of thermal regulation within the limits, allowing servicemen to fulfill their statutory duties within the required time period.

If for shoes and clothing, the software developed by the authors makes it possible to formulate requirements for a package of materials and ensure a comfortable state of servicemen for the performance of their official duties, then for a person, a hand, for a big toe, it guarantees comfortable conditions without additional research on the selection of packages of materials. fails.

The characteristics of materials for gloves, the use of which would be justified, is given in table 7.

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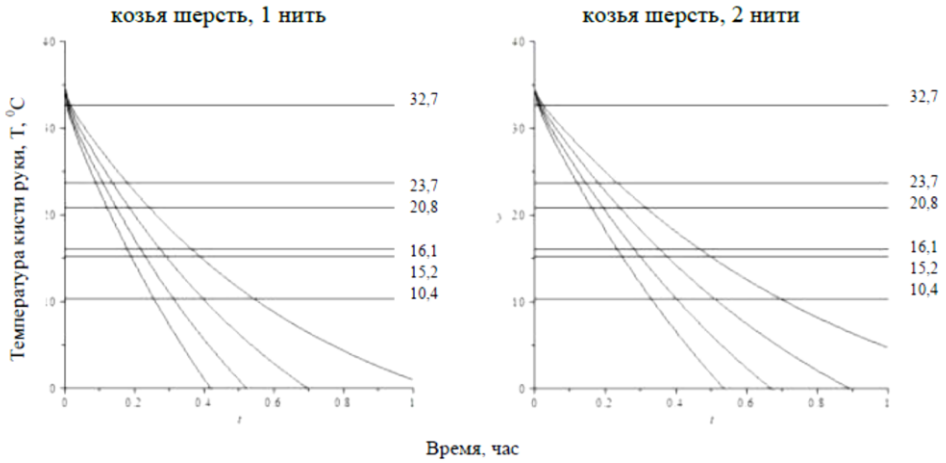

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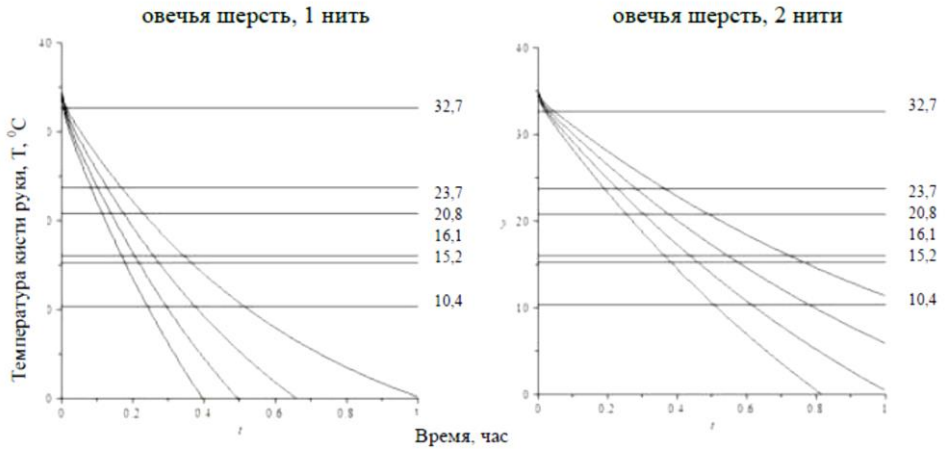

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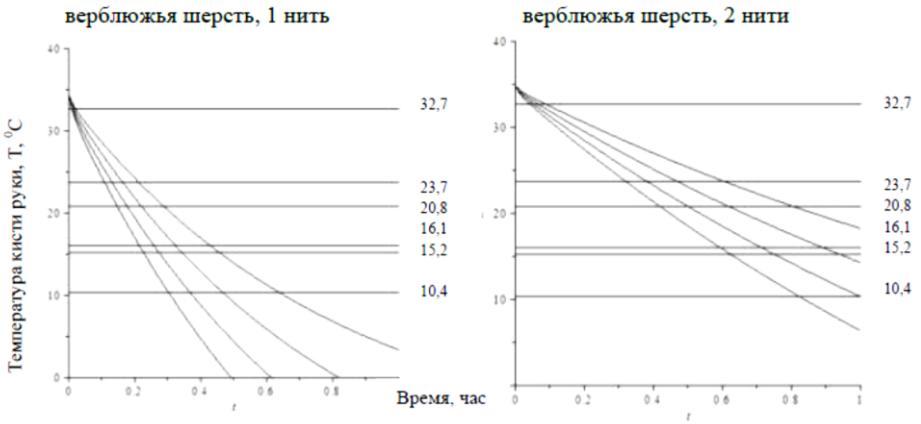

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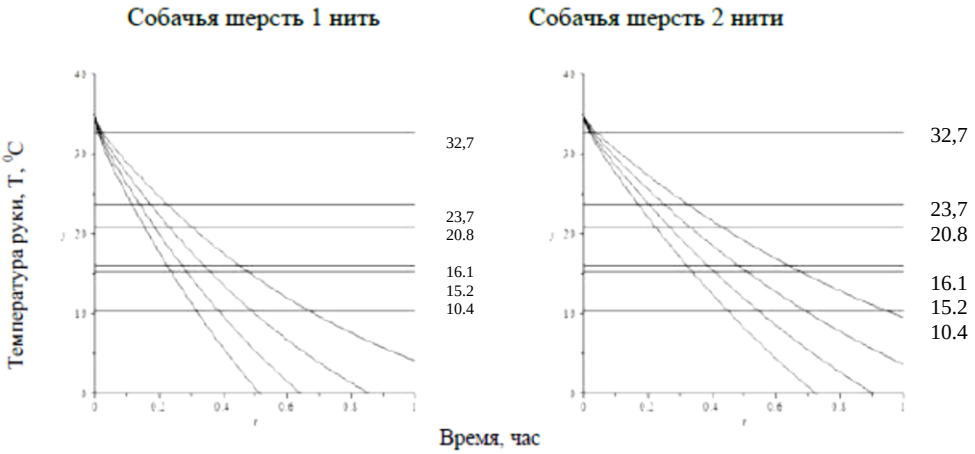

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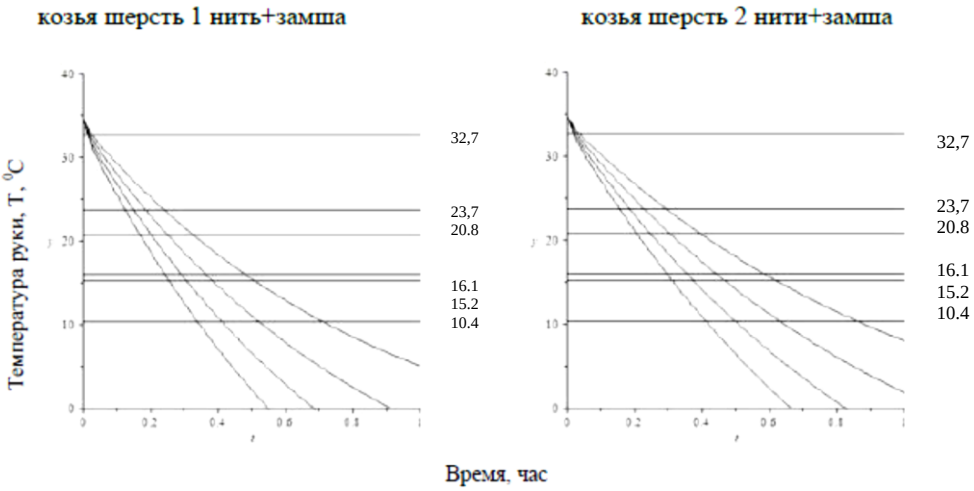

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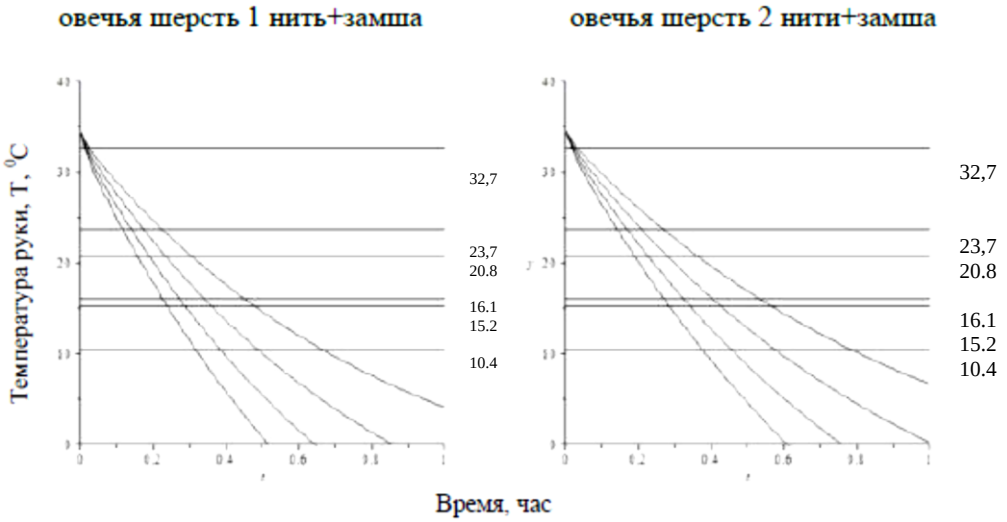

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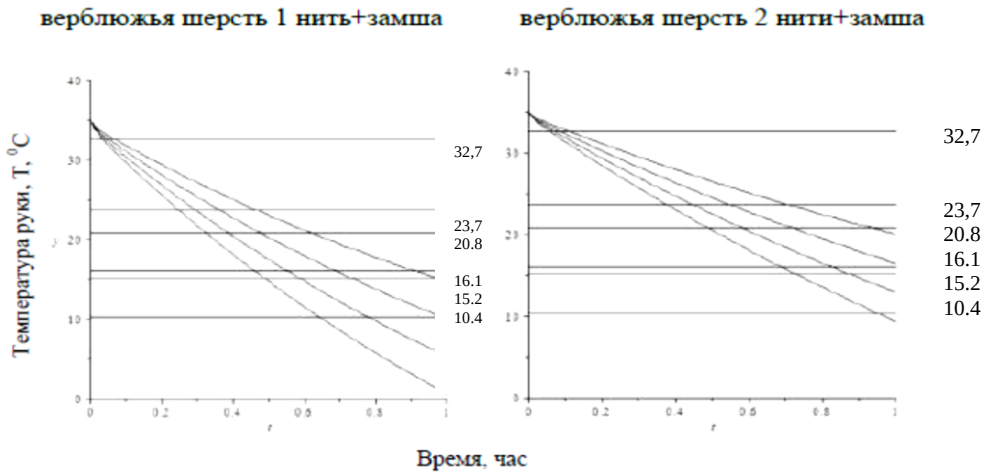

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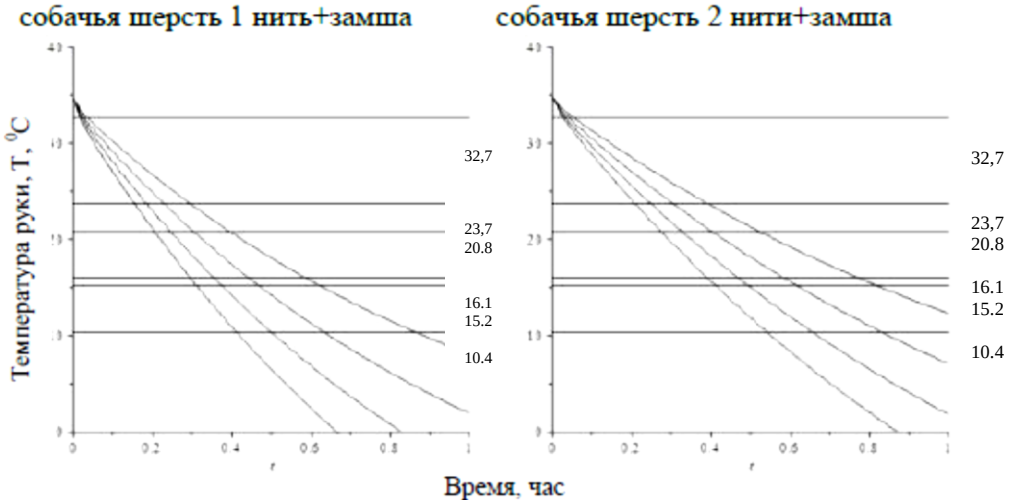


h) Change in the temperature of the skin of the hand when using dog wool yarn from 1 thread + suede and 2 threads + suede for gloves

Figure 6 - Characteristics of the state of comfort of the hand (skin) of a serviceman when he is in various climatic conditions: curve 1 - at -10 ° C, curve 2 - at -20 ° C, curve 3 - at -30 ° C, curve 4 - at -40 ° C

Consequently, the results obtained substantiated the high efficiency of using the software for a reasonable selection of packages of materials for gloves and other sets of suits for Arctic servicemen and confirmed the need to continue research on the selection of such materials that would provide them with a comfortable state in a given temperature regime for at least one hour.

For the packages and materials shown in Table 7, curves are plotted characterizing the state of comfort of the serviceman's hand for the following ambient temperatures, namely, curve 1 - at -10 ° C, curve 2 - at -20 ° C, curve 3 - at -30 ° C, curve 4 - at -40 ° C (Figure 1).

The software developed by the authors allows the manufacturer to have a tool for making an informed decision on the choice of packages of materials for the suit of the Arctic military personnel, including in the production of gloves to protect the hand from the effects of low temperatures in the performance of their statutory duties.

Confirmation of these conclusions is the analysis of the properties of the most effective from the point of view of comfortable conditions of the skin of the hand, carried out by the authors, providing a constant temperature within 32.5 ° C.

Unfortunately, gloves made from wool yarns of various animals, made from both one and two threads, do not guarantee servicemen such a comfortable state even at a temperature of -10 ° C, not to mention that the air temperature may be lower. In this case, the surface of the skin of the hand is cooled below the critical value, i.e. below 10.4 ° C and can lead to frostbite and irreversible processes.

The use of mitts to protect the hand also does not guarantee servicemen protection from the effects of low temperatures, suggesting the search for such materials and the formation of bags from them for the manufacture of gloves that would provide them with comfortable conditions, which is possible when using nanomaterials capable of thermal regulation within the limits, allowing servicemen to fulfill their statutory duties within the required time period.

Cold is one of the harmful environmental factors affecting humans. Reactions to the effects of cold can be both functional and pathological in nature: disease, defeat, death.

At low temperatures, a person can experience cold stress. Cold stress can be caused by the cooling of the body as a whole or part of it, most often the face and respiratory organs, hands, feet. At the same time, different types of cold stress are formed due to a combination of climatic factors, physical activity, clothing, etc. The main types of cold stress are:

- cooling the whole body;
- cooling of the limbs;
- skin cooling (convective);
- skin cooling (conductive);
- respiratory cooling.

The combinations of climatic factors are as follows:

- air temperature, average radiation temperature, air mobility, physical activity, relative humidity of air, clothing;
- air temperature, air mobility;
- the surface temperature of the clothing;
- air temperature, physical activity.

The effect of cold stress on humans is due to the intensity of cold stress (tissue cooling).

Hypothermia is a result of extreme cold stress intensity.

The results of the intensity of cold stress of the 1st degree will be:

- local cold damage - frostbite, numbness;
- cold damage without freezing;
- pain;
- functional damage;
- acute cardiorespiratory effect;
- deterioration in performance;
- discomfort;
- heat balance.

Discomfort can cause a decrease in activity, especially in relation to solving problems associated with neuro-emotional stress, with the need to concentrate, and also increase the risk of occupational accidents and injuries. Moreover, cooling of tissues can lead to decreased physical activity, which contributes to the risk of accidents.

Cooling of a person, both general and local (especially of the hands), contributes to a change in his motor activity, disrupts coordination and the ability to perform precise operations, causes the development of inhibitory processes in the cerebral cortex, which can cause injury. With local cooling of the hands, the accuracy of the combat mission is reduced; activity decreases by 1.5% for each degree of decrease in the temperature of the fingers.

A drop in body temperature, muscle and skin temperature leads to a decrease in the ability to perform physical work due to a decrease in the level of metabolism.

These changes reduce coordination and can lead to an increase in accidents, especially when performing a combat mission in the cold. The sensitivity of the receptors also changes with a decrease in skin temperature. So, at a skin temperature of 20 ° C, it is 1/7 of normal.

The above means that a set of thermal protective clothing intended for work in open areas, in particular in climatic regions IA and IB ("special" and IV climatic zones), must include protective equipment for the face and respiratory system.

The hands and feet play an important role in thermoregulation, being specific heat exchangers between the body and the environment. The state of thermal comfort is provided at a foot skin temperature of 29-31 ° C and a heat flux of 52-87

W / m2. The thermal resistance of the tissues remains within the range of up to 0.3 clo.

Studies by a number of authors have shown that with an increase in the thermal insulation of shoes, the weighted average temperature of human skin increases (from 32.0 ± 0.30 to 33.5 ± 0.32 ° C) and the weighted average heat flux decreases (from 90.3 ± 4.0 to 57.0 ± 0.32 W / m2 (≈ 40%)). A decrease in total heat loss as a result of an increase in the thermal insulation of shoes can be 17.1 ° C.

Heat loss by convection and radiation from the surface of various areas the human body when it is cooled:

a) head 19.0 W (12%);
b) hands 44.4 W (31%);
c) trunk 36.0 W (25%);
d) legs 49.0 W (32%);
e) whole person 148.4 W (100%).

The amount of insulation in a shoe can have a significant impact on a person's overall heat loss and body surface temperature. This means that when developing thermal protective clothing, the requirements for thermal insulation of all areas of the body must be met. With an increase in the thickness of the package of materials for insulating clothing, almost only the temperature of the skin of those areas of the body that are protected (trunk, shoulder, thigh) rises... ABOUTthere is only a slight increase in skin temperature in the area of the hands. A change in temperature, depending on the degree of warming of the surface of the body, is practically not observed.There is a definite relationship between the general thermal state of the body and the degree of cooling of a particular area of the body, in particular, the feet and hands. At the same time, the thermal insulation of the latter has a significant effect on the general heat exchange of a person.

The basis for the creation of thermal protective clothing for operation in the Arctic should be based on a scientific principle that takes into account the physiology of heat exchange between humans and the environment.

Requirements for materials and construction thermal protective clothing in the Arctic:

- the heat-shielding ability of clothing for protection from cooling is determined by the thermophysical parameters of the package of materials from which it is made, by design, type (jacket, jacket and trousers, overalls, etc.);
- a package of materials for heat-protective clothing is formed from a base material, an insulating pad and a lining. If necessary, to reduce the air permeability of the package of clothing materials, a windproof pad can be used, which should be placed between the base material and the insulation pad;
- the main material (cover, outer layer) determines the appearance of clothing and performs protective functions. It must have protective properties that correspond to the conditions of activity, be resistant to mechanical stress, precipitation, light, various types of pollutants, and be easily cleaned of contaminants. It must be able to conduct moisture from the clothing space into the environment and have adequate air permeability to the wind speed.

The work considers the process of cooling the surface tissues of the knee and elbow of a person when exposed to low temperatures (table 8).

Table 8 - Characteristics of the package of materials for the protection of the elbow and knee joints

Model	Package materials	Thickness, mm	Thermal conductivity coefficient λ, W / m ºC
1	2	3	4
Model 1	cotton linen	0.9	0.044
	Wool sweater or pants	2.4	0.027
	Nylon lining	1.6	0.042
	Thinsulate insulation (1 layer)	6.0	0.044
	Arctic-tech - outer layer (85% PE + 15% cotton)	1.8	0.041
	Arctic-tech (knee pad or elbow pad)	1.8	0.041
Model 2	Thermal underwear	1.76	0.039
	Wool sweater ooze pants	2.4	0.027
	Nylon lining	1.6	0.042

	Thinsulate insulation (21 layers)	12	0.036
	Arctic-tech - outer layer	1.8	0.041
	Porous rubber - damper	2.2	0.027
	Arctic-tech (patch pocket)	1.8	0.041

For the description, a mathematical model is built in the form of a boundary value problem:

$$\frac{\partial T_i}{\partial t} = a_i\left(\frac{\partial^2 T_i}{\partial r_i^2} + \frac{2}{r_i}\frac{\partial T_i}{\partial r_i}\right) + \frac{q_{iv}}{c_i\rho_i}, \quad (21)$$

$$i = 1,2,\dots n,$$

$$T_1(0,t) \neq \infty;$$

$$\lambda_n \frac{\partial T_n}{\partial r_n}(R_n,t) + \alpha(T_n(R_n,t) - T_c) = 0; \quad (22)$$

$$T_{i-1}(R_{i-1},t) = T_i(R_{i-1},t); \quad (23)$$

$$\lambda_{i-1}\frac{\partial T_{i-1}}{\partial r_{i-1}}(R_{i-1},t) = \lambda_i\frac{\partial T_i}{\partial r_i}(R_{i-1},t),$$

$$i = 2,\dots n.$$

Initial conditions, where $T_i(r_i,0) = f_i(r_i)$ t – time; - temperature of the i-th layer; T_i $i = 1,\dots n$; - ambient temperature; - coefficient of heat capacity of the i-th layer; - coefficient of thermal diffusivity of the i-th layer; - the density of the i-th layer; - coefficient of thermal conductivity of the i-th layer; volumetric heat flow density of the i-th layer; heat transfer coefficient from the surface of the skin or protective layer (hair, hat); $T_c c_i a_i \rho_i \lambda_i$ $q_{iv} - \alpha - f_i(r_i)$ – initial temperature of the i-th layer.

The solution to the problem is in the following form

$$T_i(r_i,t) = \sum_{k=1}^{\infty} D_k(t) X_{k,i}(r_i), \quad (24)$$

Where

$$X_{k,i}(r_i) = \frac{1}{r_i}\left(A_i \sin\left(\frac{\mu_k r_i}{\sqrt{a_i}}\right) + B_i \cos\left(\frac{\mu_k r_i}{\sqrt{a_i}}\right)\right) -$$

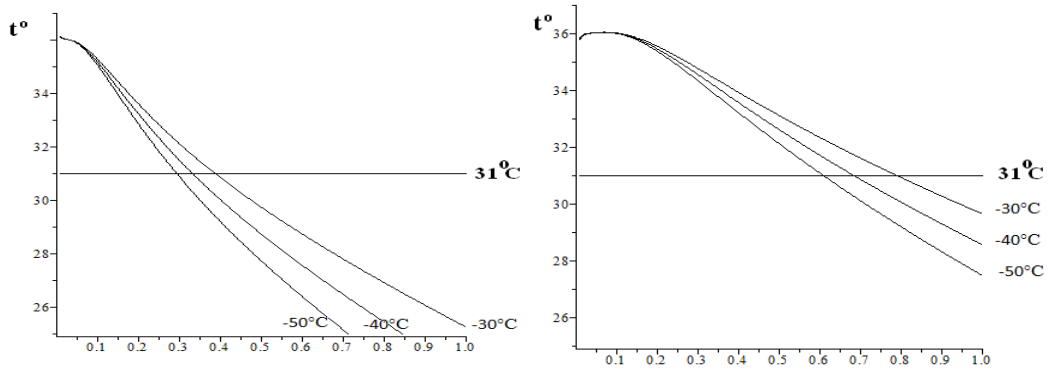
eigenfunctions of the corresponding boundary value problem:

$$\frac{\partial^2 X_i}{\partial r_i^2} + \frac{2}{r_i}\frac{\partial X_i}{\partial r_i} + \frac{\mu^2}{a_i}X_i = 0, \quad (25)$$

$$X_1(0,t) \neq \infty;\ \lambda_n \frac{\partial X_n}{\partial r_n}(R_n) + \alpha X_n(R_n) = 0; \quad (26)$$

$$X_{i-1}(R_{i-1}) = X_i(R_{i-1}); \quad (27)$$

$$\lambda_{i-1}\frac{\partial X_{i-1}}{\partial r_{i-1}}(R_{i-1}) = \lambda_i\frac{\partial X_i}{\partial r_i}(R_{i-1}).$$



a) **b)**

Figure 7 - knee:
a) model 1; b) model 2

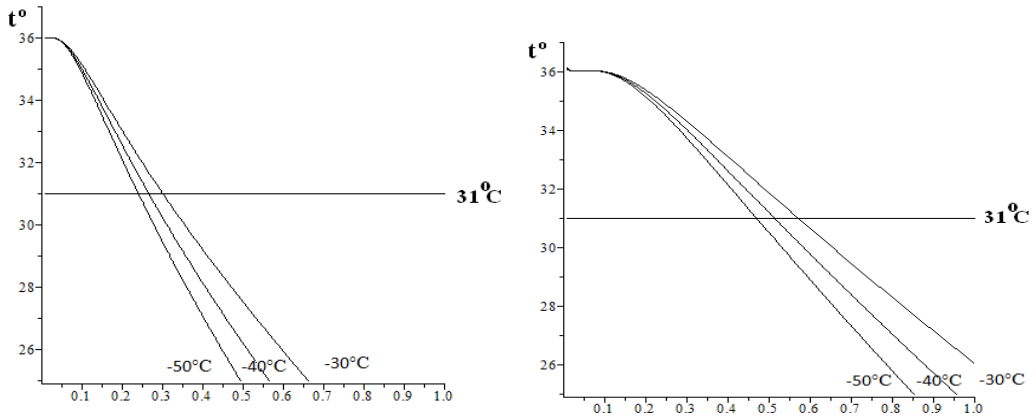


Figure 8 - Elbow:
a) model 1; b) model 2

The article presents the results of studies on the reasonable choice of packages of materials for knee and elbow pads in order to ensure comfort for servicemen in the Arctic during the entire time of his stay in climatic zones with low temperatures. The approbation of the software product has confirmed its high efficiency.

Conclusion

To select the optimal capacity, the authors have developed software that allows manufacturers, based on an innovative technological process using universal and multifunctional equipment, to produce the entire assortment of shoes with minimum, average and maximum costs, which creates the basis for varying the price niche, including through a gradual increase in the share of domestic components in the production of leather goods with a significant reduction in the cost of its manufacture. At the same time, as the criteria for a reasonable choice of the optimal power when forming the algorithm, it was justified to choose exactly those criteria that have the greatest impact on the cost of the finished product, namely:

- load factor of workers,%;
- labor productivity of one worker, a couple;
- losses on wages per unit of production, rubles;
- specific reduced costs per 100 pairs of shoes, rub.

Of the four given criteria, in our opinion, the main ones are labor productivity of 8 workers and unit reduced costs.

Labor productivity of 1 worker is the most important labor indicator. All the main indicators of production efficiency and all labor indicators, to one degree or another, depend on the level and dynamics of labor productivity: production of products, number of employees, expenditure of wages, level of wages, etc.

To increase labor productivity, the introduction of new equipment and technology, widespread mechanization of labor-intensive work, automation of production processes, advanced training of workers and employees, especially when introducing innovative technological processes based on universal and multifunctional equipment, are of paramount importance.

Specific reduced costs - an indicator of the comparative economic efficiency of capital investments, used when choosing the best option for solving technological problems.

The given costs are the sum of current costs, taken into account in the cost of production, and one-time capital investments, the comparability of which with current costs is achieved by multiplying them by the standard coefficient of efficiency of capital investments. Tables 9 and 10 show the calculations of the optimal power for the range from 300 to 900 pairs for men's and women's shoes for the entire range of footwear. Analysis of the characteristics obtained for three variants of a given technological process in the manufacture of the entire assortment of footwear confirmed the effectiveness of the software product for evaluating the proposed innovative technological process using universal and multifunctional equipment. So with a range of 300 - 900 pairs, the best according to the given criteria is the volume of production of 889 pairs (for men) and 847 pairs (for women). If the production areas proposed by the regional and municipal authorities of two districts - the Southern Federal District and the North Caucasus Federal District, according to standard indicators, do not allow the calculated production volumes to be realized, then the option of the optimal capacity is chosen that is acceptable, for example, the production volume of 556 pairs, which corresponds to the standard indicators for the proposed production areas and is characterized by the best values of the designated criteria, which form the cost of the entire assortment of footwear. The authors have developed summary technological processes for assembling a shoe upper and assembling shoes for 12 models of men's and 12 models of women's shoes, respectively. The summarized volumes of the main costs are shown in Table 9.

Table 9. - Calculation of the optimal power with a range of 300-900 pairs using the example of men's shoes

Power	Equipment type	Optimal power, steam per shift	Labor productivity of 1 worker, steam	Worker load factor,%	Losses on wages per unit of production, rub	Specific reduced costs per 100 pairs of shoes, rub.
300-500	1	500	28.09	61.39	13.68	6735.36
500-700	1	556	27.73	69.14	9.83	6404.71
700-900	1	889	28.09	77.20	6.42	5236.17
300-500	2	500	28.09	61.39	13.68	6728.68
500-700	2	556	27.91	68.70	9.97	6083.28
700-900	2	889	28.09	77.20	6.42	5240.72
300-500	3	500	28.09	61.39	13.68	7533.95
500-700	3	700	28.12	67.28	10.56	6734.02
700-900	3	889	28.09	77.20	6.42	5876.59

To assess the effectiveness of the production activity of a shoe company, it is necessary to analyze the annual results of the enterprise for the production of men's and women's shoe assortment.

Table 10. - Calculation of the optimal power with a range of 300-900 pairs using the example of women's shoes

Power options	Type of equipment	Optimal power, steam per shift	Performance labor of 1 worker, couples	Workers load factor,%	Losses on wages per unit of production, rub	Specific reduced costs per 100 pairs of shoes, rub.
300-500	1	500	27.73	62.18	13.40	6980.5
500-700	1	700	27.73	69.14	9.83	6277.43
700-900	1	847	27.73	74.50	7.54	5673.49
300-500	2	500	24.45	63.90	14.11	7630.92
500-700	2	556	27.73	69.14	9.83	6404.71
700-900	2	812	25.64	75.40	7.77	6060.55
300-500	3	500	27.00	61.74	14.02	7827.12
500-700	3	556	29.32	68.21	9.71	6607.65
700-900	3	847	27.00	74.70	7.66	6341.05

These calculations indicate that with 100% of sales of men's and women's shoes in the specified period of time, not only the costs of production and sales of products are covered, but also a profit of 3,697.4 thousand rubles remains. This testifies to the effective operation of the enterprise, as well as the correct marketing and assortment policy. The product profitability is 14.9%.

Shoe enterprises should focus both on external (consumer enterprises, competition, market conditions, etc.) and on internal factors such as sales volume, profitability, coverage of basic costs, etc. However, it is impossible to take into account and foresee all situations that may arise when selling shoes, i.e. some shoe models are no longer in demand at a certain stage.

Thus, the regions on the territory of which the territories of advanced socio - economic development, including footwear, are organized, become leaders in economic development, determine the competitiveness of the economy of these regions, and provide social protection to the population of these regions.

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