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Прохоров В.Т., Якубенко К.С., Селина Н.Г. Особенности использования пакета материалов при изготовлении костюма для военнослужащих Арктики

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Materials and peculiarities of military clothing
of soldiers in the arctic regions

В статье представлено исследование особенностей использования пакета материалов при изготовлении костюма военнослужащих Арктики. Современные костюмы состоят из тринадцати предметов которые защищают человека от длительного воздействия холода, дождя, пронизывающего ветра и налипающего снега. Кроме того, комплект позволяет свободно передвигаться, с относительным удобством носить боевую экипировку, применять оружие и за счет светло-серого цвета хорошо маскироваться на местности

Ключевые слова: костюм военнослужащих Арктики, полимерные материалы, теплоизоляция, влагостойкость

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In this article the authors represent the research of features of use of the materials packet in case of production of a suit of the military personnel in the Arctic Regions. Modern suits consist of thirteen items which protect the person from long impact of cold, rain, wind, severe conditions and the sticking snow. Besides, the set allows to move freely with the opportunity to carry fighting equipment, to use the weapon and due to the color it is good to mask in the district

Key words: military clothing of soldiers in the Arctic Regions, polymeric materials, thermal insulation, water resistance

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At the present time one of the directions of military clothing industry is making professional clothes for different operations in a climate of the Arctic Regions. The process of survival in Polar Regions directly depends on the military equipment and suits which are able to protect the consumer and preserve his or her body temperature.

The first requirement to the military clothing under the conditions of the Arctic Regions is multiple layers. The top layer has to be moisture resistant, the middle layer should include woolen or synthetic fibers, and the internal layer of the suit has to possess good air-permeable qualities. The second requirement is that the suit has to be comfortable to wear. It is provided with sufficient air circulation that doesn't provoke overheating of the body.

Today army protective clothing is improved really quickly and in a revolutionary way, using the latest achievements in a scope of polymeric materials and technologies. According to the world scientists the use of modern protective clothes from polymeric materials, for example, in the USA army has allowed them to reduce human losses by 15%.

It is necessary to confirm that the creation of comfortable background for the soldiers in extreme conditions of the Arctic Regions, the scientists of many countries of the world work together including with active participation of leaders of the research centers of Russia, the USA, France, Germany, Japan, South Korea, China, etc.

The climate of the Arctic, classified as polar, is characterized by long, cold winters and short, cool summers. The cold is one of the most harmful factors of the environment influencing soldiers. An organism response to the cold can be different: the disease, stress, chill, death and so on. The main types of the excessive heat loss are: cooling of all body; cooling of skin; cooling of extremities; respiratory cooling and so on.

Consequences of the excessive heat loss depend on the quality of clothes and level of energy consumption, his activities, a state of health, sensitivity of an organism, etc.

Therefore the level of body resistance to the cold is formed by the combination of several factors: climatic conditions, clothes, physical activity, health condition of the person, etc.

Metabolic cost under the conditions of cold climate increases. It occurs due to decrease of the activity, caused by cooling, and also growth of power consumption of work as a result of use of heavy clothes. That's why the clothes of soldiers in the Arctic Regions should be frost-proof, winter-proof, moisture-resistant but at the same time light and comfortable.

As for the Russian army, it has fully completed the transition to wearing new all-season sets of field uniforms, while soldiers deployed in the Arctic have been provided with new Arctic uniforms.

The Arctic uniform is a set of clothing and equipment of the military personnel passing military service in the conditions of especially severe climate. The set provides protection against long influence of cold with high humidity and wind more than 15 meters per second, from heavy rains and the sticking snow, from the influence of conditions of the sea frigid and humid climate.

The set is created in accordance with the modular principle that's why the military personnel for creation of a comfortable state can combine various products of the set depending on climatic conditions and their level of activity.

The set provides high mobility and freedom of movement of the soldiers in the conditions of especially severe climate, convenience of carrying the weapon, equipment and elements of an armored protection, speed of dressing-up and removal in various situations, masking in the district.

The Arctic uniform set consists of 13 objects:

1. The underwear which is moisture wicking;
2. Linen special (fleece);
3. Helmet protective mask;
4. The winter cap;
5. The winter suit (jacket, bib-and-brace overalls and vest);
6. The suit warmed (a jacket and trousers);
7. Gloves special warmed;
8. Mittens;
9. Boots for the military personnel;
10. The summer peak-cap for the military personnel;
11. The summer suit (jacket and trousers);
12. T-shirt;
13. A bag luggage for storage and carrying of a set of ware property.

This set provides all soldiers and military personnel passing military service in the conditions of especially frigid climate according to the list approved by the Chief of the General Staff of the Russian Armed Forces – the First Deputy Minister of Defense of the Russian Federation.

Structurally all-season sets of field uniforms is the universal set intended for operations in different climatic zones of Russia in temperature modes higher than +15 and to -40.

The Arctic set as well as the all-season sets of field uniforms is made according to the principle of layer-by-layer construction – all elements are compatible among themselves, the materials of the set provide reasonable ratio and balance of processes of thermoregulation of a human organism.

The Arctic set was initially created for operations in especially cold conditions (low temperature -50, -60 both strong wind and snow) and has special constructive decisions, such for example as:

- very high collar of an anatomic form of a jacket;
- a special hood, the increased volume which is possible to regulate in the different directions, in front part of a hood there is a wire allowing to change the size of cut of a hood and to fix him (protection against wind and snow);
- in the lower back part of a jacket there is a pocket into which the substrate from polyurethane foam is inserted;
- in the bottom of the jacket there is a special valve which is clasped between legs and it doesn't allow the wind to blow;
- on a jacket and trousers there are special wind-shelter skirts;

- in the bottom of sleeves there are special warm cuffs and additional extension, for prevention of hit of cold inside;
- the fleece warmed suit has the high collar of a jacket which is regulated on the upper edge and there is a very wide belt of trousers that in addition warms a solder's back;
- the warm fleece linen has the high collar providing an additional heat-shielding and comfort;
- the protective mask has the special heat exchange element allowing to breathe freely in the conditions of low temperatures;
- mittens have a special opening for a thumb that gives the chance to use the weapon (to pull the trigger) without removing mittens;
- the jacket of a winter suit has an additional removable heater which can be used in addition as a vest separately from a jacket;
- trousers of the winter suit are made in the form of semi-overalls that in addition warms a solder's back;
- the boots facilitated with high wide tops, a special frost-resistant sole with protection against sliding, the drawstring on top of the bootleg prevents snow hit inside, there is a unique warm package of materials of a membrane protecting from low temperatures (to -60).

The uniform for especially frigid climate has always been provided by the Soviet and the Russian armies. Earlier the winter suit was made of natural materials, for example, kersey and fur. The uniform used to be heavy and quickly lose its cold-resisting properties getting wet.

A new uniform is made of the modern light materials which greatly protect from wind, moisture, keep heat, and at the same time hygienic, washable and quickly drying materials are applied.

The producers of sports and tourist equipment have good materials and facilities for creating good equipment and clothing for cold conditions. Their advanced experience has been taken into account at designing of different elements of a set.

Thermal characteristics of materials were calculated on the basis of normative documents (GOST - All Union State standard) on special clothes and footwear for protection against the lowered temperatures and with accordance to the methodical indications of the Russian Ministry of Health according to a thermal condition of the person for the purpose of justification of hygienic requirements to a microclimate of workplaces and measures of prevention of cooling and overheating.

The thermal insulation of footwear can have significant effect on the general heat losses of the person and temperature of a surface of a body. It means when developing thermal protective clothes the requirements to thermal insulation of all areas of a body should be carried out. With increase in thickness of a package of materials of the warming clothes practically only temperature of skin of those areas of a body which are protected (a trunk, a shoulder, a hip) increases.

Change of temperature depending on extent of warming of a surface of a body is practically not observed. It is possible to allocate a certain interrelation between the general thermal condition of a human body and extent of cooling of this or that area of

a body, in particular, of feet and hands. At the same time thermal insulation of the hands has significant effect on the general heat exchange of a human body.

Another interesting feature of the Arctic uniform is its coloring. The camouflage coloring of fabric and materials is the approved camouflage coloring, but it's not made in habitual protective colors and in shades of gray color that provides masking in the Arctic district.

If we consider the Russian Arctic uniform, then it is possible to say that for production of these suits only materials of a domestic production and Republic of Belarus are used.

Today there is a question whether it is possible to compare our Arctic uniform to the Army uniform of foreign countries of the Arctic zone and whether they have such sets which are superior to our analogs.

For example, Armies of Canada, Norway, Denmark, Finland provide clothes sets for a frigid climate, but in the process of creation of the Russian set our national producers were supported mostly by the experience of creations of working clothes for our companies working in conditions of especially frigid climate and clothes for the Russian polar explorers at the same time considering military specifics (compatibility with equipment, availability of the bullet-proof vest and body armor helmet, etc.).

One more important aspect of use of the Arctic uniform is the duration of the thermal effect.

The comfortable condition of the uniform wearing is will be surely provided within two hours if the soldier is at rest. Time of extreme duration is about 6 hours. At the active movement time of operation the duration increases.

Four thousand sets of the Arctic uniform will be purchased and delivered in military bases in 2016. In 2015 more than 2,1 thousand sets of the Arctic uniform are delivered.

However the Arctic uniform needs special care. Common practice with the uniform shows that it should not be starched. The use of starch, sizing, and any process that involves dry-cleaning or steam press will adversely affect the treatments and durability of the uniform and is not authorized.

Starching the uniform has been shown to cause discoloration. It makes the uniform inappropriately colorless and faded.

Personnel have been instructed that the uniform must be washed with a mild detergent that does not contain "optical brighteners." Detergents with optical brighteners may cause discoloration of the uniform, which would nullify the purpose of the very specific camouflage design and result in possible unwanted detection of personnel using the uniforms in combat. Some detergents have phosphorescent properties which enhance an enemy's ability to see the soldier when viewed with night vision devices.

To sum up, we can mention the basic requirements to thermal protective clothes:

- the main thermal protective function of clothes is the protection of a body of the person from excessive return of heat in external environment;
- compliance of heat-insulating indicators of the clothes, physical activity of the person and the weather conditions in which the uniform will be used;

- thermal insulation of the uniform has to be adjustable;
- the clothes have to promote removal of moisture from subclothes space therefore inside layers of the uniform have to not only absorb the sweat emitted by a body of the person, but also give moisture to the following layers;
- the clothes shouldn't lead to overheating of a body of the person; some cooling is necessary for stimulation of physical activity and the fastest acclimatization to cold is admissible;
- when warming various parts of a body of the person it is necessary to proceed from the general thermal insulation of thermal protective clothes and efficiency of warming.

The scientific principle taking into account physiology of heat exchange of the person with environment has to be the basis for creation of thermal protective clothes for operation in the conditions of the Arctic.

There are several requirements to materials and design of the thermal protective clothes, which are the following:

- thermal protective ability of the clothes intended for protection against cooling of a body of the person consists of heat-physical indicators of packages of materials of which it is made, and also depends on a design (a jacket, a jacket and trousers, overalls, etc.);
- the package of materials of thermal protective clothes is formed of the following materials: the basic material, lining and the warming laying.

For decrease in air permeability of packages of materials of clothes, if necessary, application of wind-shelter layer which is necessary to put between an external layer and the warming laying is possible.

- the main material performs not only protective functions, but also bears in itself esthetic indicators, causing appearance of clothes. It has to possess sufficient indicators of protective properties which correspond to conditions of activity of a person and his or her activities, to be steady to mechanical influences, influence of light, atmospheric precipitation, different kinds of pollution, and also it should be easy to be cleared and washed.

The thermal condition of the person is subdivided into the following categories: optimum, admissible, maximum permissible and inadmissible. The optimum thermal condition of the person is characterized by absence of the general or local uncomfortable heat feelings. The admissible thermal state is characterized by insignificant general or local uncomfortable state. The maximum permissible thermal condition of the person is characterized by the expressed general or local discomfort that limits his activity. The inadmissible state is characterized by the excessive cooling leading to violation of a state of health.

Thus we can say that the Arctic uniforms perform a lot of important functions, have different models and variations and this kind of military clothing is designed for soldiers working in severe Arctic climate, that's why it should be comfortable, light but at the same time frost- and water-resistant, provide optimal conditions for active work and physical exercise.

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