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Features Of Increasing Some Of The Physical And Mechanical Properties Of Fabrics For Workwear

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Abstract – This article is devoted to improving the hygienic properties of fabrics of workwear used in hot climatic conditions. The development of the optimal fabric for use in high average daily temperatures has its own characteristics. The study of the characteristics of fabrics for workwear showed that in the manufacture of such kind of special clothing, a quantitative assessment of the intensity of sweating is of great interest. The fabrics of these special clothes must have air permeability, which ensures the exchange of air under the clothing with the external environment to remove body fumes and normal heat transfer.

Keywords – Hygroscopicity, Air Permeability, Vapor Permeability, Moisture Absorption, Cotton, Modal, Viscose.

I. INTRODUCTION

Atmospheric pressure is not constant and changes with altitude, season and climate. And the parameters of the state of the air fluctuate with fluctuations in atmospheric pressure. Evaporation-condensation and movement of water, sorption of fibers and the effect of the atmosphere on mass transfer in porous media are important phenomenon that can significantly affect moisture exchange. At low atmospheric pressure, the peak temperature, vapor concentration and tissue saturation are higher than at high pressure. The atmospheric pressure gradient is an important factor affecting liquid water, steam and heat transfer in hygroscopic tissues [1].

The workwear system plays a very important role in determining the temperature of the human body and other thermal reactions of the worker during work, because it determines how much heat generated in the human body can be exchanged with the environment. With the development of new technologies, it becomes more and more important to know how the workwear system will behave when interacting with the human body in hot climatic conditions. In order to obtain a comfortable working space, it is necessary to understand the thermal and hygroscopic behavior of the garment [1].

II. MATERIALS AND METHODS

Workwears should not restrain the worker during the work process and satisfy the needs arising from their intended use, and should also be comfortable. Comfort affects not only the well-being of the worker, but also his performance and efficiency. For normal labor activity of the worker, a kind of climatic zone, a microclimate, must be created around his body. The temperature of the layer of air adjacent to the body under clothing and its stability depends on the temperature and speed of movement of the

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surrounding air, the properties of the clothing and the state of the human organism. For workers working in hot climates, it is important that work clothing provides protection and good moisture wicking [2].

Fabrics for workwear must be breathable, allowing the air under the garment to be exchanged with the air of the environment to remove body fumes and normal heat transfer. Good air permeability and vapor permeability is especially necessary for workwear fabrics used in hot climatic conditions [3].

The vapor permeability of a fabric is understood as its ability to transmit water vapor from an environment with a higher air humidity to an environment with a lower air humidity. The penetration of water vapor through fabrics can occur through the pores between the threads, similar to air penetration, or it is carried out due to the hygroscopicity of the fibers forming these fabrics.

If the air is saturated with more water vapor on one side of the fabric than on the other, the fabrics absorb moisture from the more humid air and release it into an environment with a lower relative humidity. The intensity of steam penetration in this case depends on the properties of the fibers, the difference in temperature and relative humidity on both sides of the fabric.

The vapor permeability of the workwear fabric ensures the timely removal of water vapor and other vaporous products released by the worker's skin. Insufficient vapor permeability leads to the retention of vapors (sweat) in the air layer under clothing [4].

III. Results and discussions

An increased body temperature of a worker can significantly worsen the results of work. Wearing workwear made from highly absorbent (SH) fabrics with good moisture absorption properties can lead to better working results for workers compared to wearing slightly absorbent clothing. This is determined by the following properties of SH textile fibers:

- High absorption of evaporated sweat between the inner layer of clothing and the surface of the skin, which enhances heat transfer by evaporation of sweat due to the greater moisture gradient of the evaporative heat transfer process;
- The release of heat of sorption associated with the absorption of moisture by hygroscopic fibers, which raises the temperature of the fabric to increase dry heat transfer from the outer surface of the fabric [5].

Most textiles have some degree of moisture absorption (called hygroscopicity). Hygroscopicity is the ability of tissues to absorb water from the air in the form of water vapor. The hygroscopicity of textile materials is influenced by their chemical composition and molecular structure. Depending on the presence of more or less hydrophilic groups (hydroxyl OH, carboxyl COOH, amide CONH) capable of attracting and retaining water particles around them, textile fibers are more or less hygroscopic [3]. Therefore, at the same relative humidity and air temperature, different textile materials have different moisture content [6].

As environmental conditions change, the moisture content of textiles changes. The process continues until an equilibrium is established between the moisture content of the material and the moisture content of the environment [3]. The ability of textile materials to change their moisture content in accordance with environmental conditions determines one of the essential hygienic properties of clothing - to absorb vaporous secretions from human skin [6].

The rate at which moisture is absorbed and released is not the same for different fiber materials. Fabrics made from plant fibers quickly absorb and also quickly release moisture and body vapors to the external environment. This property of plant fibers is valuable for workwear materials used in hot climates. The absorption of moisture in the structure of cellulose fiber mainly occurs due to adsorption in a fibrous bulk material, for example, on the surface of voids and pores [7].

The rate of moisture absorption also depends on the structure of the material. The denser and more compact the fabric, the greater its thickness and the slower the process proceeds [3].

Studies carried out with workwears have revealed that a mixture of polyester and cotton is widely used as the main component of materials in the manufacture of overalls for workers [8], [9], [10]. However, blends of cotton and polyester have low hygroscopicity and air permeability [11], but they are used to increase wear resistance, reduce wrinkling and shrinkage of fabrics for workwear.

A material concept that combines the favorable moisture sorption properties of cellulosic fibers with the water-repellent properties of synthetic fibers could be an interesting hybrid between synthetic fibers and cellulosic materials. The ideal fabric is expected to have a hydrophobic surface, but still be absorbent, which will promote evaporation and effective cooling. At the same time, it will be hygroscopic and will absorb moisture vapor near the skin [12].

IV. Conclusion

Synthetic fibers exhibit low resistance to moisture absorption, while protein fibers exhibit excellent moisture absorption, anti-static behavior, comfort in virtually all environmental conditions and aesthetic qualities necessary for the development of workwear.

Fabrics made from cellulose fibers are a material with a high water attraction, which means that in hot climates they absorb sweat from the body and transfer it through the threads to the outer surface of the garment. Thus, the body maintains its temperature and the clothes are perceived as comfortable.

To improve the hygienic properties of workwear, a blended fabric made of natural fibers - cotton and artificial fibers - viscose and modal is recommended. Unlike most man-made fibers, viscose and modal are environmentally friendly fibers as they are made from wood cellulose. They do not contain toxic substances and any other harmful impurities. For tlhe manufacture of viscose and modal fibers, high-quality and natural wood is used - pine, beech or eucalyptus. Viscose and modal have a number of advantages over natural fabrics: a high degree of hygroscopicity and air permeability, lightness, environmental friendliness, durability, comfort. Such a complex of useful properties of viscose and modal makes them most suitable for regions with hot climates.

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