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# **Analysis of innovative technologies in the manufacture of composite lining materials**

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**ABSTRACT:** At present, a number of high-tech composite materials are used as lining materials for the production of leather products, differing in the variety of means and methods for their production. The analysis of innovative technologies for their production made it possible to determine the composition and methods of joining the compositions, the technology of manufacturing and the methods of fixation on the fabric, which allows programming special properties that meet environmental requirements when designing the product.

**KEYWORDS:** Shoes, lining, artificial leather, membrane, construction, process, molding, fixing method, products.

## **I. INTRODUCTION.**

In recent years, the basic hygiene requirements for footwear for special purposes have increased the requirements for ensuring comfortable footwear properties. All these requirements for shoes are directly related to the materials of the top and lining, as well as to the inner materials of the bottom of the shoe. These materials directly contact with the foot and the hygienic properties of the latter form the properties of the shoes themselves.

Despite the availability of a wide range of footwear and special materials, the world is intensively conducting research in the field of developing new materials, the reliability of construction, improving the quality and functionality of footwear. Among the diverse range of products of the artificial leather industry and film materials there are such types, analogues of which are produced in other industries [1]. Thus, non-woven and film materials are produced in the chemical, construction, automotive industries, porous and monolithic rubbers - in the rubber industry, cardboards produce cellulose-paper and timber industries. However, none of the above industries produce materials that would be raw materials for footwear, leather, sewing and other light industry industries and would meet the needs of people in good products. These products of artificial and synthetic materials are in direct contact with the person, predetermining the microenvironment of his life, the conditions of the functioning of the organism, the feeling of comfort or discomfort when wearing shoes. Given that there are nerve centers on the human foot that affect the general health of the person through the spine, considerable attention is paid to the shoe material, especially to the insole and lining. Therefore, among the complex set of performance indicators, the hygienic properties of shoe materials are among the most important.

One of the priority areas for the development of the leather and footwear industry is the development of environmentally safe production technologies and the use of effective materials [2].

A characteristic feature of artificial leather and non-woven film materials is a complex, multilayer structure (fibrous base, basic and finishing coatings). Each element of macrostructure, each layer of the system contributes to the overall strength and other properties of materials, predetermining the time and degree of preservation of aesthetic, hygienic and other properties of the products.

The basic requirements for footwear materials include the following:

- materials should not contain chemicals that have a harmful effect on human health;



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- be comfortable and hygienic; Absorb pairs of cutaneous respiration, keep your feet and shoes dry all day, keep the body warm;

- to have high indexes: strength to abrasion, elasticity, form stability and resistance to formation of creases.

Depending on the purpose of shoes, materials are also subject to special requirements for properties:

- heat protection and frost resistance;

- deodorization and sorption;

- fire resistance.

The choice of packages of materials for the top and bottom of the shoe is based on an analysis of the properties of materials, the way they are fastened together in the package, manufacturability, functionality, cost, the rate of consumption of the product, and compliance with aesthetic requirements.

Currently, the footwear industry does not have universal materials that are simultaneously resistant to all physiological and hygienic requirements. The materials used for the production of footwear differ in both types and technological parameters. The industry uses a wide range of natural, synthetic and artificial materials and technologies for their processing [3].

Thus, the creation of composite lining materials for the production of leather products has two objectives: [4]

- firstly, development of a technology for the production of import-substituting gasket composite materials based on local raw materials;

- secondly, giving these materials the desired set of properties, in particular vapor permeability, water resistance, thermal conductivity, elasticity, etc.

Depending on the purpose, artificial skins of different structures are created: monolithic, porous or porous-monolithic. Depending on the pore formation method, a different pore structure can be created: closed (cellular), with open communicating pores (spongy structure) and combining in its structure closed and open pores of various shapes and sizes. [5]

For the production of non-woven and lining materials of various types, compositions based on polymers such as rubbers and their latexes, polyurethanes, polyamides, nitrocellulose, polyvinyl chloride, etc. are used.

Nonwoven composite materials and soft artificial leathers are produced by calendaring, laminating and laminating and soaking. In this case, the penetration into the substrate can be either through-flow or superficial (an alluvial method).

Often use a combination of end-to-end impregnation with subsequent application of the face layer and finish [6].

One of the main advantages of natural leather is the isotropy of its structure. This quality is particularly important when cutting out parts of products, tight-linging operations during the manufacture of shoes, deformation of products during operation. The difference in elongation in the longitudinal and transverse directions of materials for the top of the shoe should not exceed 6%. The natural skin when molded on the shoe lengthens at a tension of 1 MPa by 25-30%, and the fabric - only by 8-12%. Therefore, the properties of nonwoven materials should approximate these indicators [7].

Shoe materials must be well molded to the foot when the shoes are worn, and since the lining materials are in contact with the skin of the foot, they also need to provide camphor properties of the shoes.

Artificial soft leathers and lining materials are used mainly for the top of the shoe, while for the interior parts natural lining leathers are used, produced from low grades of skin without a face layer. Deficiency of natural lining skins determined the development and application of new in structure and perfect for production technology lining composite materials for footwear.

Considering the ecological situation in the world, today in many countries high-tech innovative non-woven materials are being actively introduced into the production process, which are more economical and necessary for a person in the modern world. Experts evaluate non-cellular materials as an important innovative product of tomorrow [8].

At present, a number of high-tech composite materials, called "membrane" materials, are used as gasket materials. These materials represent the original structure of the interlacing of various synthetic threads of different thicknesses and are the discovery of a decade that makes it possible to manufacture shoes with an entirely new degree of reliability, strength and durability. *The membrane* in the narrow sense of the word is a film capable in one way or another (in the form of water vapor through the pores or by diffusion of individual molecules through the membrane material itself) to transport moisture through itself along the air humidity gradient (that is, to the side where the water vapor in air less). Since the strength of the membrane is extremely low, then for use it is attached to a tissue base.

The analysis of innovative technologies in the manufacture of shoe shoe materials used in world practice made it possible to draw the following conclusions:



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1. For the production of composite lining materials are used materials:
    - in the form of melts, plastisols, solutions, dispersions;
    - compositions based on polymers: rubbers, polyurethanes, polyamides, polyesters, polyvinyl chloride, nitrocellulose, etc .;
    - as a basis use: fabrics, knitwear, non-woven materials, polymer films or sizing.
  2. Methods of combining the compositions:
    - glue, thermal and foam rubber-fire methods, pressing.
  3. Methods of preparation:
    - calendering, laminating, laminating, impregnation.
  4. Method of penetration into the substrate:
    - through and surface (alluvial method).
  5. Methods of creating a porous structure:
    - mechanical, chemical, phase separation of solutions.
  6. According to the technology of manufacture are distinguished:
    - membranelaminated - laminated membrane (in this case, the finished membrane sheet is glued to the tissue base);
    - membranecoating - coating with membrane properties (in this case, the membrane is applied to the tissue base directly in liquid form).
  7. Types of membrane materials:
    - Hydropore (the most famous - GoreTex) membranes consist of pores through which moisture (sweat) is discharged outside, and water does not penetrate from the outside;
    - hydrophilic (the most common - SympaTex) membranes are a continuous film that does not allow water to pass through.
  8. Types of membrane fixation in tissue:
    - 2-layer structure (2L)* - the membrane on one side is attached or applied to the fabric.
    - 2.5-layer construction (2.5L)* - also consists of a membrane and an external fabric, but the inner surface of the membrane can be coated with a protective coating of polyurethane or carbon particles. It can have the form of drops, strips of squares, or be solid.
    - 3-layer construction (3L)* - the membrane is protected by a cloth on both sides. The inner layer is trying to make it as light and breathable as possible.
  9. In their structure, membrane tissues are:
    - *Bessporovye* - membrane tissues, working on the principle of osmosis;
    - *Pore* - the molecules of steam formed on the inside of the tissue are freely discharged through the special pores;
    - *Combined* - the inner side of the fabric is a porous membrane, over which a non-porous polyurethane film is applied in the form of a thin coating.
- Thus, the analysis of innovative technologies in the production of composite lining materials allows us to conclude on the variety of means and methods for obtaining them, which allows programming special properties that meet environmental requirements when designing the product.

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