properties with innovative technologies and eco-oriented yarns and fibers. This will ensure product competitiveness on both domestic and international markets while meeting contemporary consumer demands.

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UDC 677.027

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ANTIBACTERIAL TEXTILE IN THE MEDICAL INDUSTRY: A REVIEW OF MODERN TECHNOLOGIES AND PROSPECTS

Purpose. *Analyze modern approaches to providing antibacterial properties to textile materials. Identify the advantages and limitations of the most common antimicrobial agents. Systematise the requirements for medical textiles: safety, biocompatibility, preservation of functional properties after repeated washing, environmental neutrality.*

Keywords*: antimicrobial effectiveness, medical textiles, textile materials, biostability.*

Objectives. Economically developed countries are observing a clear trend towards the continuous expansion of the range and growth in the production of medical devices, which differ in their functional purpose and manufacturing technologies [1]. This contributes to the formation of separate markets for medical textiles, which are developing dynamically. Given the significant volumes of imports of these products, it is relevant to create our own market for antibacterial products in our country [2]. Economically developed countries are observing a clear trend towards the

continuous expansion of the range and growth in the production of medical devices, which differ in their functional purpose and manufacturing technologies [1]. This contributes to the formation of separate markets for medical textiles, which are developing dynamically. Given the significant volumes of imports of these products, it is important to create our own market for antibacterial products in our country [2]. The aim of the study is to justify the concept of antibacterial medical textiles as an innovative product on the Ukrainian market, which creates the basis for its further development.

Medical textiles are the main component for ensuring safe conditions in medical institutions. Medical textiles (gowns, underwear, dressings, covers for medical furniture) usually come into contact with pathogenic microflora. This creates a risk of spreading infections. The use of textile materials with antibacterial properties can significantly reduce the risks of contamination. Maintaining a stable antibacterial effect during operation and multiple washing cycles is a necessary factor in contamination.

Methodology. The study is based on an analysis of scientific publications, international standards relevant to the antimicrobial properties of textile materials. A comparative method was used to assess the effectiveness of different treatment technologies.

Research results. Scientific publications describe two main approaches to creating resistant antibacterial textiles [3]:

- *Modification in the production process* – introduction of antibacterial agents (silver, copper, zinc ions, nanoparticles, chitosan, quaternary ammonium compounds, etc.) directly into the fibrous mass.
- *Final processing of finished textiles* – application of special compositions that form indelible bonds with fibers.

Standard methods are widely used to assess effectiveness: determination of zones of growth inhibition of microorganisms (S. aureus, E. coli, P. aeruginosa), measurement of microbial load reduction after a given number of washes, as well as comparative tests of control and modified material samples. Analysis of current literature sourses shows that the most effective are nanoparticles of silver, zinc and copper, which provide prolonged antibacterial action. Organic antimicrobial substances (chitosan, quaternary ammonium compounds) demonstrate good biocompatibility, but are inferior in terms of stability after repeated washing. The use of a product of the phenyl-phenol series demonstrates effective stability of the antibacterial effect even after repeated washing [4]. Table 1 shows the classification of medical textiles with antibacterial properties.

Table 1 – **Classification of medical textiles with antibacterial properties**

Product group	Examples	Main purpose
Surgical and medical clothing	Gowns, suits, masks, shoe covers, caps	Barrier protection, reducing the risk of cross-infection
Underwear and bedding	Sheets, duvet covers, pillowcases, mattress covers	Hygiene in hospitals, prevention of the spread of microorganisms
Operative coverings and napkins	Sterile and non-sterile coverings, napkins	Creation of aseptic conditions during surgical interventions
Bandaging materials	Gauze, bandages, non-woven fabrics with antibacterial additives	Prevention of infections in wounds, accelerated of healing
Filtration materials	Masks, respirators, filters for ALV devices	Combination of antibacterial properties with high filtration
Technical medical textiles	Furniture upholstery, curtains, coatings	Resistance to frequent disinfection, long-term exploitation

The current task is to create medical textiles that reduce the risk of pathogen colonization on the surface and in the wound channel, retain physical, mechanical and operational properties during operation and repeated washing, are biocompatible, safe for the patient and environmentally acceptable [5]. Analyzing the literature reveals the main requirements for medical antibacterial textiles (Table 2).

Table 2 – **Basic requirements for medical antibacterial textiles**

Requirement	Description
Antimicrobial effectiveness	Inhibition of the growth of pathogenic microorganisms (S. aureus, E. coli, P. aeruginosa, C. albicans, etc.)
Resistance to washing and sterilization	Retention of effectiveness after repeated cycles of washing, autoclaving, chemical disinfection
Safety	Absence of toxicity, irritation and allergic reactions, biocompatibility
Hygienic characteristics	Optimal air and vapor permeability, hygroscopicity for the comfort of staff and patients
Mechanical strength	Resistance to tearing, friction, creasing and repeated use
Fire resistance (if necessary)	Required for materials of operating and sterile rooms
Compliance with standards	Compliance with requirements of ISO 20743, ISO 18184, DSTU, EN, ASTM and other standards

Currently, promising research approaches include:

1. Development of “heterogeneous” systems. Combining mechanical (topographical) and chemical (ionic/biopolymer) agents to reduce the risk of resistance and increase durability.

2. Controlled and localised release. Projecting the matrices with predicted release kinetics (higher action in the first 24–72 h, then maintenance at a low-level), optimal for postoperative care.
3. "Green" synthesis routes. Implementation of biosynthesis, use of biodegradable carriers and avoidance of harmful biocides.
4. Integration of diagnostic elements. Development of textiles with indicators of pH change, increased bacterial activity or release of volatile compounds for early detection of infections.
5. Transition from in vitro to in vivo and clinical studies. Systematic studies: in vitro antimicrobial tests → in vitro biocompatibility (cells) → in vivo healing/infection models → controlled clinical trials.
6. Life cycle assessment and regulatory documentation. Each new agent or technological process requires a life cycle assessment and compliance with medical standards (biosafety, sterilization, labeling).

Thus, the main practical areas of application for antibacterial textiles in the medical fields are:

✓ bandages and wound dressings: controlled-release membranes that combine antimicrobial properties and wound healing stimulation;
✓ post-operative stockings/covers: compression products with long-lasting antimicrobial treatment to prevent infections;
✓ disposable surgical textiles with biodegradable antimicrobial coatings;
✓ medical staff clothing: products with antimicrobial properties that reduce the risk of carrying pathogens.

Conclusion. The results of the conducted research confirm the feasibility of forming a specialized market for textile materials and medical products in Ukraine. The potential main consumers of such a market are medical institutions of various profiles and areas of activity, as well as pharmaceutical enterprises. The concept of developing medical textiles as a new product is based on the need to meet the needs of domestic medicine and pharmacy in high-quality, environmentally friendly materials of a new generation that can increase the effectiveness of treatment, reduce the cost of healthcare and solve a number of urgent issues of the industry.

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УДК 677.494.674 :677.017.2: 677.032.1

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EFFECT OF KNITTING TECHNOLOGICAL PARAMETERS ON THE PERFORMANCE PROPERTIES OF KNITTED FABRICS ENSURING PROTECTION AGAINST MECHANICAL DAMAGE AND FIRE

***Objective**. To investigate how knitting process parameters affect the development of functional properties in knitted fabrics designed for hand protection applications.*

***Keywords:** meta-aramid yarn, para-aramid fibers, high-strength knitted fabric, personal protective equipment, protective gloves.*

Introduction. The development of textile materials with protective properties remains a significant challenge for ensuring worker safety in demanding industrial conditions. Knitted fabrics produced from para- and meta-aramid fibers combine high strength and flame resistance, offering considerable potential for personal protective applications. However, selecting the optimal fabric structure and knitting parameters that determine the functional performance of such materials requires further investigation.

Modern textile materials used in personal protective equipment are characterized by high resistance to cutting, puncture, and thermal exposure. These properties are achieved through the introduction of high-strength fibers and polymers with protective coatings, as well as the use of composite and multilayer structures. In a recent review of advances in technical textiles [1], special attention was drawn to the effectiveness of aramid fibers, which provide mechanical durability and exhibit lower susceptibility to flame-induced degradation. It has been shown that the