**OPEN ACCESS**

Volume: 12

Special Issue: 2

Month: February

Year: 2024

E-ISSN: 2582-6190

Impact Factor: 4.118

Received: 17.12.2023

Accepted: 18.01.2024

Published: 14.02.2024

Citation:
Aishwarya, R., and M. Sumithra. "Importance of Antimicrobial Finishes in Sportech: An Overview." *ComFin Research*, vol. 12, no. S2, 2024, pp. 193–200.

DOI:
https://doi.org/10.34293/commerce.v12iS2-Feb.7581



# Importance of Antimicrobial Finishes in Sportech: An Overview

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**Abstract**

*Technical textiles are distinct from other types of textiles because their purpose is not to be aesthetically pleasing or decorative, but rather to have specific functional properties and technical performance.Textiles can be made to have unique functions by applying surface finishing agents and surface treatments, or by incorporating specialty fibers and polymers. Barrier, protection, improved comfort, medication, sensory, actuation, and shielding are a few examples of these functions.One of the biggest manufacturers of products in the Packtech, Clothtech, Hometech, and Sportech segments of technical textiles is India. The demand for these technical textile products has increased dramatically in India. It is anticipated that the technical textiles market will reach a valuation of $325 billion by 2025–2026, up from its current $260 billion. India's technical textile market, currently valued at $22 billion, has come a long way. The government is determined to raise it to an incredible $40–50 billion within the next five years. The study thus explores the performance of specific Sportech producing segments of the Indian technical textile industry through production.Recently, there have been incidents all across the world thatrise in the number of people engaging in active sports. In the fiercely competitive realm of sports, there are now moreathletes in the professional ranks. Additionally, since sports directly contribute to maintaining their physical and mental fitness, people view them as an essential component of their daily activities. Global consumption of active sportswear has significantly increased in both quality and quantity.Moisture and heat management are the main concerns that must be met in a textile intended for sports applications in order to ensure proper thermophysiological and tactile comfort. Using specific fibers, yarns, and finishes, additional unique qualities are added to clothing while taking hygiene and health into consideration to create a comfortable fit.A thorough discussion has been held regarding the types of fabrics, finishes and recent advancements in sportech.*

**Keywords: Technical Textile, Sportech, Moisture, Heat Management, Hygiene & Health, Antimicrobial Textile Finishes**

## Introduction

In addition to serving as an insulator against the elements, clothing can serve as a hygienic barrier, preventing infectious agents and dangerous materials from coming into contact with the body. It can ease foot pain and injury or help with navigation in a variety of settings. The two main categories of textile products are conventional textiles and technical textiles. Technical textile products are those that are used in functional applications, while conventional textile products

are designed, developed, or used for common, decorative, or aesthetic purposes.These technical textiles are designed for applications requiring high performance and technology.UV protection is another benefit of clothing.In actuality, playing sports can greatly improve a person's quality of life in terms of things like blood pressure, brain activity, and physical form. For people to be able to improve their overall health and quality of life.

The design of active wear is still being researched by academics and professionals in the industry.In many textile products, such as apparel, furnishings, sportswear, and health and hygiene items, antimicrobial activity is desired. In the market, these are becoming more well-known and in demand.Considering the need for active wear is rising among three demographic groups: (i) women who participate in competitive sports and aerobics; (ii) people over the age of 55 and (iii) children. The four comfort attributes thermo-physiological comfort, tactile/sensorial comfort, mobility, and psychological comfort should all be met by a well-designed sports textile. This might be accomplished by controlling air permeability and moisture vapour effectively while maintaining the necessary thermal insulation.

Sportswear's comfort and flexibility, moisture-wicking qualities, support for particular body parts, capacity to control body temperature, and lightweight, breathable design are its primary benefits.High-quality compression garments aid in preventing injuries and muscle inflammation. Compression garments improve heart blood flow, which supplies working muscles with much-needed oxygen.Consumers' concerns regarding antibacterial efficacy and comfort of wear have emerged in the market for sportswear and active wear.The technical specifications state that sportech should be designed with both functional and esthetic purposes in mind. Sports-related activities will determine the type of application and fabric used. The fabric should have the following functional properties: low fluid resistance, UV protection, stretchability, light weight, vapour permeability, and the ability to absorb and release perspiration. The softness of the fabric's surface texture, handle, color, lusture, comfort, and fit are the aesthetic applications.

**A View on clothing worn actively**

Functional textiles are materials with integrated components for controlling or modifying a particular application. The functional properties of the material are incorporated into it at different stages of the manufacturing process, such as when it comes to the fiber, yarn, fabric, or garment stages. The bulk of functional materials used are chemical agents with the capacity to control a variety of functional properties, such as water repellence, flame-retardant, UV-protecting, antibacterial, crease and fluorescent whitening agents, and antimicrobial activity. Nonetheless, the most significant challenges in the development of functional textiles are related to material selection, product design, and manufacturing procedures.Based on a number of studies, the global functional textile market is expected to reach USD 4.72 billion in 2020, growing at a Compound Annual Growth Rate (CAGR) of 33.58% between 2015 and 2020 due to the commercial applications of these materials in the health care, sports, fitness, fashion, military, and automotive sectors (Majumdar et al., 2019). Because of this, it is projected that the use of functional textiles will increase over time and that additional research will be required to address challenges and meet demand.

For instance, certain textiles may have fibers that reduce odor or wick moisture to keep the wearer cool.The primary functions needed for high-intensity sports are sweat absorption, quick drying, and cooling.Depending on the season, the fabrics' properties can be altered to suit the wearer's needs. For better breathability, for instance, light and loose clothing is used in the summer. But in the winter, air packets created by brushing the textiles inside give you better insulation and keep you warm. The ability to better prepare for the game is a benefit of this trait, especially during warm-ups.

Socks with antimicrobial finishes are necessary to avoid foot ulcers. Antimicrobial functional socks help prevent foot ulcer infections, which affect about 23 million people in the US with diabetes. It was stated that there was no such product offering ongoing control of the bacteria and fungi causing the foot ulcer in the American healthcare system, (Uddin, 2016). Underwear and socks with antimicrobial and antifungal finishes for military personnel. Market for sportswear that includes items like caps, sport bras, gloves, socks, and more. The factors to design a sportswear is comfort, protection, looks fashion, costing, fit and hygiene.

**The Characteristics Required for Sportswear**

- Thermal insulation properties
- Moisture wicking properties
- Light weight fabrics
- Elastic quality
- Compression properties
- Weather-proof properties
- Durability and ease maintenance

In light of these characteristics, the textile industry is essential in producing fabric that is appropriate for sportswear. Moisture management property is an important aspect of any fabric meant for active wear garments, which decides the comfort level of that fabric specially used as active wear garments. A fabric moisture management performance is also influenced by its air and water vapour permeability. The moisture management finish and antimicrobial finish have been used to increase moisture absorbency, improves wetting, wicking action and antimicrobial performance. Thus, antimicrobial textile products continue to increase in popularity as demand for fresh smelling and skin friendly, used mainly in sport textiles.

**Types Sports and its Applications in Sportwear**

At present, sports textiles are being used more frequently. Sports textiles include apparel and sports equipment used in a variety of sports as well as clothing and yoga mats. Golf, Tennis, Mountaineering, Skiing, Cricket, Football, Volleyball, Swimming, Summer and Winter Sports, and Olympic Games all use T-shirts, Trousers, Shorts, Jerseys, Tracksuits, Caps, Sports bras, Shoes, and various sports equipment like football/volleyball, sports net, gloves, pads, mats, etc. Athletes' jockstraps and innerwear are also included. Sportswear can also be used for unique purposes, such as swimming suits, sleeping bags, ballooning, and parachute materials (textileblog.com).

Sportswear is made of a variety of knitted, woven, and non-woven textiles. However, a popular material for sportswear is polyester. It is essentially a long-lasting, lightweight, wrinkle-free, breathable, and comfortable fabric composed of plastic fibers. The synthetic fibers are polyester, polyamide, polypropylene, acrylic, Nylon, spandex and high performance fibers are aramid fiber, Novoloidfiber, PPS fiber, PCM fiber, Kevlar are used in sportswear. The fabrics used are Tricot, Quilted, Mesh, Fleece, Micro fiber, 3-Layer softshell and 2.5-Layer coated, (Sinha, 2021).

**Importance of Antimicrobial finishing**

Antimicrobials prevent, eliminate, or inhibit the growth of microorganisms and the unpleasant odor, discoloration, and deterioration that they can cause.Ardusso., et al (2020)The COVID-19 pandemic has led to a notable surge in the manufacturing and application of metal nanoparticle-based antiviral textiles, such as face masks, gloves, protective suits, shoes, and other items. Such personal protective equipment disposal errors could have a long-term detrimental impact on the environment.Chowdhuryet al., (2014), According to their leaching action, antimicrobial

agents used to treat textiles are divided into two groups: "static" and "cidal." To make textiles antimicrobial, antibacterial, and antifungal, a wide variety of antimicrobial agents are currently offered on the market. Owing to the last 20 years' explosive advancements in nanoscience and technology, different metal nanoparticles have been created and added to synthetic and natural textiles to provide antimicrobial properties that range from non-durable to durable.

Gocek&Duru (2019), The textile industry has been using Meryl Skinlife, an antibacterial polyamide fiber with silver particles in it, more and more. It is primarily used for seamless clothing, which is specifically intended for activewear and sportswear.Lipp-Symonowicz et al., (2011)Natural antimicrobial agent coatings on textiles or fabrics have their origins in ancient Egyptian mummy wrap preparation, which involved the use of spices and herbal coatings on linens. Historically, bamboo fibers, known as "Bamboo-kun," an antimicrobial compound, were used for building materials by the Chinese.Gulati at al., (2021) Fashionable clothing requires not just antimicrobial qualities but also materials with durability, color, prints, and design. As a result, many commercial brands are now emphasizing these kinds of materials. An overview of the scientific aspects of various fabrics, including natural or synthetic antimicrobial agents, as well as their current and potential applications.

An odor can only be fully characterized by taking into account four factors: intensity, character, hedonics, and detectability. The only factor that has been considered in the creation of statutory regulations for offensive odors is detectability. Using the herb on 100% cotton denim fabric, a study was conducted to screen for functional properties from natural herbs for the Antiodorfinish and to assess the properties of the finished fabrics before and after washing using the Microencapsulation and Nanoencapsulation methods, (Sumithra, 2015).

**Microbes or Micro organisms**

Microbes are the tiniest organisms that are imperceptible to the naked eye. According to Gopalakrishnan&Aswin (2006), It is made up of many different kinds of microorganisms, such as bacteria, fungus, viruses, and algae. As unicellular organisms, bacteria proliferate fast in warm, humid conditions. Fungi, molds, and mildew are slow-growing, complex organisms that leave stains on fabric and reduce its functionality. Microorganisms can be bacterial or fungal, and to grow and leave deeper stains on textiles, algae requires continuous exposure to sunlight and water sources. Eight-legged dust mites can be found living in carpets, mattresses, pillows, bed linens, and other household textiles. Human skin cells are consumed by dust mites, and the waste materials they discharge into the atmosphere can cause allergic reactions and respiratory problems. The examples may include Staphylococcus epidermis and coryeformbacteria, cause body odor, Bacillusand smaller amount of Staphylococcus aureusand Micrococcus, yeast, fungi Candida albicans,and Gram-negative bacteria produce skin infections.

**Antimicrobial Finishes in Fiberand Fabrics**

Exposure to microorganisms can result in both acute and chronic reactions, which are long-term effects. According to Uddin., (2016) The important applications of these materials in human lifestyle are made possible by the properties that are achievable in fibrous materials, which include softness, strength, bending, opacity, porosity, drapability, permeability to air and vapour, warmth and shape, and retention. The fiber products are used for bedding, floor covering, furnishings, apparel, and other purposes.As a result, several antimicrobial finishes for cellulosic fibers were released onto the market.

The important benefits achievable using antimicrobial finishing of cellulosic fibers are comfort & aesthetics, hygiene & microorganism control, conventional processing technology, biodegradability

& environment friendly, economical healthcare, technical & home textile products.In general, there are three types of known antimicrobial finishes: synthetic, natural, and semi-synthetic (obtained through the chemical modification of natural substance).Lim and Hudson, (2003) Joshi et al., and Mahesh et al. talked about the antimicrobial obtained from natural sources from plant and animal origin. When it came to antimicrobial investigations on textiles, researchers focused on examining synthetic finishes, particularly the application of nanoparticle-based finishes.

**Antimicrobial from Natural Source**

In the marketplace and in daily life, antimicrobial textiles have recently attracted a lot of attention and popularity. Research on new quality standards, such as preserving the product's inherent functionality through an environmentally friendly production process, is ongoing on a global scale (Purwar& Joshi, 2004). On the other hand, plant-based extracts and chitosan are natural biocides. The use of chitosan, a modified natural carbohydrate obtained from the deacetylation of chitin, was an exception. According to Ristic et al (2011),It was intriguing to note, though, that a range of natural materials were suggested to be beneficial in the production of antimicrobial textiles. Natural dyes and pigments as well as extracts made from plant species' leaves, stems, roots, flowers, and seeds were among these natural materials.Significantly high concentrations of antimicrobials were found in medicinal extracts made from plant materials such as leaves, seeds, stems, etc.Aloe vera, neem, pomegranate, turmeric, eucalyptus oil, grapefruit seed, tulsi leaf (Ocimumbasilicum) extract, and tea tree oil were some of these ingredients.Based on Joshi et al.'s review of natural antimicrobial products in textiles, over 10% of the planet's 250,000–500,000 plant species have therapeutic qualities.

**Antimicrobial from Animal Source**

Rajendran et al (2012) stated at, the animal-derived natural products have been applied to cotton textiles as an antimicrobial, like sericin from the cocoons of Bombyxmori silk worm which had Nontoxicity, biodegradability, resistance to oxidation, and antimicrobial activity are among its key characteristics by.McQueen et al., (2010) Using AATCC test method 100, a qualitative test method where the assessment is conducted to find the effectiveness of antimicrobial treatments in textile fibers and fabrics against Grampositive and Gram-negative strains, the main goal is to reduce odor build-up. The organisms represented by these strains are linked to nosocomial infections, such as Staphylococcus aureus, instead of the aerobic Corynebacterium or Bacillus species that cause odors.

**Methods of Application Antimicrobial Agents**

The antimicrobial fabric can be either non-leaching or leaching depending on the treatment and antimicrobial compound usedBonaldi RR (2018). Its mechanism can also be either biocide or biostatic. Microorganisms are killed by biocides, while their growth is inhibited by biostatics. These biocides and biostatics can be further classified according to whether they are intended to destroy bacteria, fungi, or viruses.In the presence of moisture, the majority of antimicrobial agents used in the textile industry leach or release their compounds under controlled conditions. The active ingredient gradually lessens as a result of the leaching action.Additives can be incorporated into the fiber matrix during the spinning extrusion process, or they can be applied to textile surfaces using a traditional coating or impregnation method like padding or exhaustion.

Applying specific chemical compounds during the finishing stage or using these compounds during the spinning of chemical fibers results in the antimicrobial effect. The production of antimicrobial textiles can involve a variety of chemical and physical processes, includingShahidi& Wiener (2012),

- Pad-dry-care method: It is the most popular application technique for press finishes that are long-lasting and require little maintenance. Prior to the crosslinking reaction that occurs during the curing step, the crosslinking reactant, catalyst, softener, and other components are dried on the fabric in this process.
- Nanotechnology:The more robust method of creating new materials with enhanced performance characteristics by using the structure and energies inherent in materials at the atomistic level, at the dimension of 10-9 nm.
- Microencapsulation:Using this technique, antimicrobial agents are applied as liquid or solid droplets to a continuous polymeric material, and the antimicrobial agent is then gradually released. When it comes to the environment, this method is less expensive than direct methods. It adds features like UV protection, thermoregulation, aromatherapy, soft feel, anti-static ability, and deodorizing finishing, (Iheaturu et al., 2019).
- Cross-linking:Use to link polymer chains together with covalent intermolecular bridges.
- Modification of fiber surface:Antimicrobials adhere strongly to textile surfaces due to this process. This could be done by using UV light, enzyme treatment, plasma technology, chemical modification, and a number of other techniques, (Radhika, 2019).

**Evaluation Methods of Antimicrobials**

A number of test techniques have been developed to assess the efficacy of antimicrobial textilesby Varesano at al (2011).

**Quantitative Antimicrobial Tests**

ATCC TM100:These tests allow one to count the number of microbes on the completed fabrics. Either a percentage or a log reduction is used to display the results. Test techniques used in quantitative analysis.

The ISO 20743: shake flask reduction method and the AATCC90 percentage reduction are used. Despite the fact that different standard techniques can be used for different types of microbial testing, most experiments can evaluate both Gram-positive and Gram-negative bacteria(Reshma&Brinda, 2020).

The Suspension Test, AATCC 100:The antimicrobial activity of textiles and fabrics against common bacteria, including S. aureus, K. pneumonia, and E. coli, is tested using a quantitative antimicrobial standard procedure over a 24-hour contact period, (Shahidi& Wiener, 2012).

**Qualitative Antimicrobial Tests**

AATCC 147 (Agar Diffusion Test): The effectiveness of antibacterial finishes applied to textile materials is assessed quantitatively using the AATCC 100 test method. Antibacterial finishes applied to fabrics protect users from dangerous bacteria and lower the chance of disease transmission, (Veresano et al., 2011).

**Research Gap**

Products made from sport textiles are typically produced using advanced technology and/ or specialty fibers, like high performance fibers. Every sports textile ought to have particular, distinctive qualities and structures. Choosing the right materials and manufacturing techniques for its construction is crucial.There are several purposes such as textile protection, presenting microorganism transmission, hygiene, resist inflammation and sensitization of the skin, a such, thus the antimicrobial finishes in port tech includes, socks, shoes, fabrics and garments according to the activity of wearer. A number of other topics, including respiratory water resistance, odorless

clothing, etc., are being associated with sports textiles and are undergoing a couple noteworthy technological developments through changes, improvement, and ongoing research.

## Conclusion

The goal of developing different functional fabrics for sportswear is to improve the wearer's overall performance. A more thorough understanding of fabrics and their functions will assist clothing manufacturers and consumers in selecting the appropriate fabric or garment for a given application, taking into account factors like weather and durability.Research is paying more attention to antimicrobial fiber finishing as people become more conscious of the need to protect human health. The natural sources for cellulosic fibers are from wood, bamboo, cotton lint, jute, flax, kenaf, sisal, hemp, roselle, coir. Antimicrobial agents are categorized into synthetic and natural groups based on the resources they contain. Synthetic agents are highly effective, but they can also pollute the environment and have unfavorable effects on human health, including allergic reactions, skin conditions, and problems with biodegradation and bioaccumulation. Conversely, natural antimicrobial agents have a narrower spectrum of activity and efficacy than synthetic antimicrobial agents, but they are still safe for use on humans and the environment. More study in this area is required to achieve this.

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