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A Review: Antimicrobial Property of Textiles

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Abstract: ***The textile materials are one of the main factors for disease transmission and the need to enhance the quality of peoples' life has stimulated intensive research and development of antimicrobial textiles. Thus, it is crucial to impart antimicrobial activity to textile materials in order to protect the user from microorganisms' contamination. Another aspect of antimicrobial functionalization of textiles is to add a therapeutic value to the material, for example, textile in the area of wound healing.***

Keywords: Agents, Antimicrobial, Environmental, Micro-Organisms, Textiles

1. Introduction

From the past, textiles were considered as low technology domain as their primary functions are protection of modesty, providing microclimate and good look. With the intensification of global competition, textile manufacturing companies from developed countries are competing for a significant share of the global market by developing new technologies or new products. Companies are trying to differentiate their products with specific and special functions based on need and requirements of consumers [1]. Chemicals which are used for antimicrobial property of textiles are toxic to humans and have problem of degradation within the environment. The textile industry has continued to search for eco-friendly processes as substitutes for toxic textile [2]. An increasing interest has been noticed in the functionalization based on environmentally-friendly and biodegradable reagents.

2. Effect of micro- organism

Microorganisms are small living forms of life that cannot be seen with the naked eye [3]. Microorganisms consist of single or multiple levels of cells and can be found in very cold or hot climates worldwide.

There are good and bad types of microorganisms. Microorganisms are the only pollutant sources that produce all forms of pollutants: particulates, gases and infectious biologicals**.** They are human irritants, sensitizers, toxic-response agents, causers of disease, and simple discomforting agents. Microorganisms are the most potent pollutants in the indoor environment, on clothes and on furnishings. They include a variety of microorganisms like bacteria, fungi, algae and viruses. Microorganisms need moisture, nutrients, water and most of them need to associate with surface of the material [4]. Soil, dust and some textile finishes can all be sources of nutrients for microorganisms. Perspiration contains salts, amino acids, carboxylic acids and other essential nutrients. Dead skin cells or oils secreted from the body skin and degraded cellulose from the textile material is good sources of nutrients for the microbial growth [5].

3. Mechanisms Involved in Microbial Degradation of Cotton

Secondary wall of cellulosic fiber may be directly damaged by fungal hypha (thread like element of fungus), and then fungus starts growing inside the lumen. In some fibers, hypha penetrates in the lumen without breaking the outside surface. Fungal hypha is coarser (5µm) than the cotton pore (16Å) or even NaOH swollen pores (40-50 Å). Bacterial decomposition of cellulose takes place from outside to inside, but it cannot digest cellulose directly. Cellulolytic microorganisms secrete enzymes, which make cellulose soluble followed by the diffusion of microbes inside the cell. As a result of enzymatic degradation, the strength of cotton reduces by about 34 per cent in 3-5 days at 40°C [6]**.**

4. Antimicrobials

The term 'antimicrobial' refers to a broad range of technologies that provide varying degrees of protection for textile materials against microorganisms. Antimicrobials are very different in their chemical nature, mode of action, impact on people and the environment, handling characteristics, durability, costs, regulatory compliance, and how they interact with microorganisms[7]. Antimicrobial is an agent that works against microbes. Agents which inhibit the growth of microorganisms and do not kill them are known as biostats, i.e. bacteriostats, fungistats. Agents which actually kill the microorganisms are known as biocides, i.e. bacteriocides, fungicides. While biostats are subject to fewer regulations, biocides are more strictly controlled by governmental regulations [8].

Necessity of antimicrobial textiles

1) To avoid cross infection by pathogenic micro organisms.
2) To control the infestation by microbes.
3) To arrest metabolism in microbes in order to reduce the formation odour.
4) To safeguard the textile products from staining, discoloration and quality deterioration[9].

5. Types of Antimicrobial Agents

Antimicrobial agents are used in the textile industry to inhibit the growth of microorganism. There are two classes of antimicrobial agents used-Synthetic and Natural.

a) Natural antimicrobial agents: Natural agents are those in which various materials from plant or animal kingdom are used.. The use of plant extracts, as well as other alternative forms of medical treatments, has enjoyed great popularity in the late 1990s. In recent years, great attention has been devoted to biopolymers because of their biocompatibility and biological functions and consequently, they are used in textile, biomedical and pharmaceutical fields. Some marine animals such as prawns and fishes possess some compounds which exhibit antimicrobial activity [10]. Chitosan is an effective natural antimicrobial agent derived from Chitin. Natural herbal products such as Neem, Tulsi, Pomegranate, Aloe Vera, Prickly Chaff Flower, Turmeric, Clove, etc. also exhibit antimicrobial activity. Studies reveal that some specific species of herbs having antimicrobial activity are suitable for textile application [11].

b) Synthetic antimicrobial agent: Synthetic antimicrobial agents used are antimicrobial Dyes, Quaternary Ammonium compounds, Polyhexamethylene Biguanides (PHMB), Triclosan (2, 4, 4'-trichloro-2'- hydroxydiphenyl ether), Regenerable N-halamine and peroxyacids and Metals and Metal salts such as Silver, Zinc, Copper. Their bactericidal activity goes on decreasing as they attach to the substrate. Furthermore, the biocide is gradually lost during the use and can be washed off the textile. For this purpose large amounts of these biocides are needed to be applied to textiles for effective control of bacterial growth and to sustain durability [12].

6. Antimicrobial Finishing Methods

Finish can be applied on the substrate by the following methods.

1) **By using spun in additives:** it is common to give the antibacterial to the synthetic fibres by incorporating bioactive agents into melt and spinning dope solution. Various antibacterial agents can be incorporated in the polymer matrix during the fibre/ yarn manufacturing process so that fibres have the permanent antimicrobial properties [3].
2) **Padding:** in this the fabric can be padded with the antimicrobial agents with expression nearly 70-80%. Along with antimicrobial agents certain crosslink, binders etc. can be used. Padding should be followed by the air drying or curing in stenter [14].
3) **Exhaust method:** in the exhaust application, the bath is prepared with the required amount and the fabric is treated in the solution for a given time. Exhaustion application is done in jet, jigger, drum etc[14].
4) **Spraying:** the spraying of antimicrobial active agent solution is not normally recommended, due to the risk of production and subsequent inhalation of droplets of respiration size. Nevertheless, the treatment can be applied by spraying provided suitable containment facilities are available. This method is particularly suitable for nonwoven fabrics. It is claimed that the commercial agents can be applied online during the dyeing and finishing operations [3,14].
5) **Micro-encapsulation:** the regulated release of the antimicrobial from within the fibres seems to be proven and viable technology for achieving good antimicrobial durability for synthetic fibres. However this technique is not suitable for cotton.
6) **Polymer modification:** this can be achieved by means of the copolymerization using monomers with bio-active functional groups. Advantage of this approach is that the bioactive elements form an integral part of the fibre, resulting in durable effects. Disadvantage is that the technology is expensive due to the need of special polymerization plants.

7. Requirements of Antimicrobial Finishing

The purpose of imparting antimicrobial activity to textiles is to protect the material from microbial attack, prevent the transmission and spreading of pathogenic microorganisms inhibit odour development resulting from microbial degradation, and create a material that will act as preventive and/or curative treatment. Ideal antimicrobial finishing needs to fulfill a number of requirements in order to achieve the maximum benefit from antimicrobials functionalized textile products [13].An antimicrobial treated material is defined as being hygienic and, therefore, should have the following requirements:

1) It should be effective against a broad spectrum of bacterial and fungal species, but at the same time it should be non toxic to consumers e.g. not cause toxicity, irritation or allergy to the user.
2) It should be durable to dry cleaning, laundering and hot pressing processes. This is the greatest challenge as textiles are subjected to the repeated washing during their life.
3) Finishing should not negatively affect the quality (e.g. physical strength and handle) or appearance of the textile.
4) Finishing should preferably be compatible with textile chemical processes such as dyeing, be cost effective and not produce harmful substances to the manufacturer and the environment.
5) It should not kill the resident flora of non pathogenic bacteria on skin of the wearer. The skin resident flora consist of several bacterial genera, which are important to the health of the skin as they lower skin surface pH and produce antibiotics to create an unfavorable environment for the growth of the pathogenic bacteria [3].

8. Classification of Antimicrobial Finish

Antimicrobial textiles inhibit the growth of microorganism. It is convenient to sub divide this general type of finish into three main groups:

1) **Rot proofing** is an antimicrobial finish applied to give material protection either long term or short term against physical deterioration.
2) **Hygiene finishes** are concerned with the control of infection and unwanted bacteria, a specialized development in the prevention of dust mites.
3) **Aesthetic finishes** are used to control odour development and staining [3, 12].

9. Antimicrobial Technology based on Purpose of Application

Among the many challenges faced, choosing the right antimicrobial technology for the nonwovens, wovens, or composite fabric industry for antimicrobial applications is one. Factors to be considered for application include:

Durability: Durable fabrics need durable features. End-uses of industrial fabrics engineered for use in medical facilities must have antimicrobial treatments that can survive abrasion, sterilization, wet/dry cycles, freeze/thaw cycles, alcohol rinse, and other physical and chemical stresses.

Waste Control/Toxicity: Antimicrobials control a range of microbial pests but in their use must be chosen and engineered so that they do not affect good and helpful microbes.

Spectrum of Activity: Many materials are antimicrobial at the right concentration but in healthcare applications it is very important to have as broad of spectrum of activity as is safe and functional. When integrating antimicrobial treatments into durable goods, this is even more important.

Adaptation: Any soluble agent that affects a microorganism's life has the potential to set up conditions where the microbial cells adapt or mutate into resistant types. Use of standard disinfectants or sanitizers call for a rinse after the desired contact time. This is to minimize the risks associated with sub-lethal levels of the antimicrobial being present and risking adaptation or other forms of resistance [4].

10. Conclusion

In the present review, the need for antimicrobial textiles increases gradually in resistant to micro-organisms. Certainly, finishes that do not leach the environment and that do not pose the possibility of breathing in particles or moving through the skin barrier and moving likely to be forward in new product. Due this authors, high lights the importance of the antimicrobial finish to textiles suitable for different domestic and industrial application.

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