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A REVIEW ON ANTI ODOR FINISHING OF TEXTILES, ITS APPLICATION METHOD AND COMMERCIALIZATION

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Abstract: Nowadays, odor has become a substantial factor. While odor in a human body is inelegance and gawkiness, that everybody would have faced. Sweat and dirt may put a person in discomposure; on the other hand, people look for cloth, which smell good and remain refreshing for longer time, thereby thriving their self-esteem. Therefore, in recent years most people ardent to wear the finished cloth that can reduce the body odor. This finish is called anti odor or novel finish. This study, discuss the different types of noisome that can be created in textiles fabrics, how this odor can be removed from fabric or what is the way to inhibit the bacterial growth to textile substrate which is responsible for producing stingy on clothing. As well as this review paper also emphasize the commercial company who have already initiated this strategy of manufacturing odor free clothing for its consumer.
Keywords: Microorganism, anti-odor, textiles, finishing process

INTRODUCTION

A wide range of micro-organism co-exists in a natural symmetry that is both in the human body and environment. This rapid and uncontrolled multiplication of non-pathogenic microbes can seriously affect the health standards.

Figure. 1 Odor in a textile cloth

The term body odor means odors generated as a result of natural functioning of human body. Odor produced by microorganisms of the skin through decomposition of skin secretions, urine and other body odor. Such odors are mainly organic compound, which contain different functional group and chemical structure. Such as amine, alcohols, aldehyde ketone phenols etc [1].

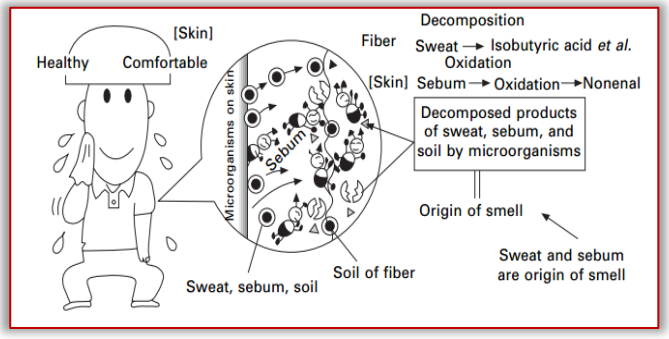

Figure 2. Odor produced in our body [2]

Table 1. A list of bad smell that creates odor in human body [1]

Origin of bad smell	Main component of bad smell	Major causes of bad smell
Bad breath	Methylmercaptain hydrogen sulfide	Bad breath of leftover fermentation by bacteria
Body odor	Trimethylamine Acetic acid Caproic acid	Decomposition of sweat constitution of microbes
Excrement	Ammonium Skatole Indole Hydrogen sulfide	Smell of feces and urine, and decompositions of feces by microbes.

CAUSE OF ODOR ON TEXTILES

Odor is often introduced on textiles from an outside source such as dirt/soil, cigarette smoke, garlic.
Most often, odor is the aftermath of bacterial growing and metabolizing on the fabric
These bacteria have migrated from the skin and uses the nutrient delivered in sweat as a food source
These metabolites are volatile and can be free from the textile itself as "offensive odors [3].

ANTI-ODOR FINISH

The finishes, which subdue or inhibit the spreading of odor or bad smell by preventing bacterial growth or neutralized the bad smell in the textile substrate. This finishing process eliminates foul smelling odors caused by pathogenic bacteria and keeping the fabric and the wearer fresh and comfortable.

The finish fabric conveys the arrest of metabolism of microbes in order to reduce the order. Additionally, the fabric does not lose its effectiveness, finishing

outcome and will continue functional virtually lasting throughout lifetime. The main chemical imparted is non-toxic and wearer friendly [5].

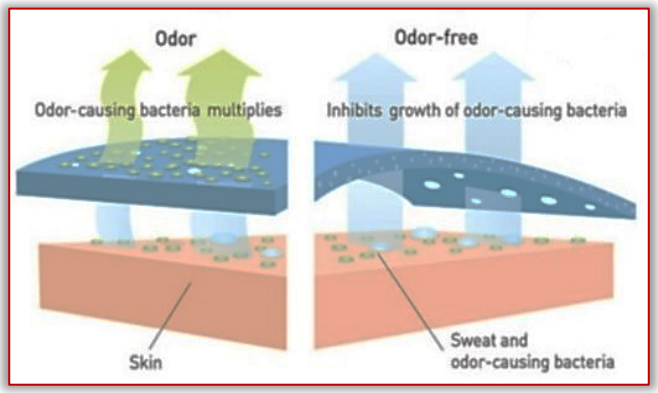

Figure. 3 Odor and odor free surface

OBJECTIVE OF ANTI-ODOR FINISHING

The medical textiles, such as fabric liners for prosthetics and casts, necessitate odor control.
The conditions (sporting, exercise, hardworking which create sweat) that damp and inclined to bacterial growth, which causes odor. Anti-odor finishing agents needs power, speed, and durability to deal with those odors.
The increasing need for incontinence odor control is not just restrain to garments, but also is required for bedspreads, linens and upholstery [6].

WAY OF CONTROLLING ODOR ON TEXTILES

Capturing Odors (Passive Approach)
Stop the Growth of Microorganisms (Active Approach)

— Capture Odors (Passive Approach)

This odor controlling method is also called passive method but it is more than 90% efficient method where odor producing component especially moisture and gases are absorbed by the zeolites or activated carbon like odor absorbers.

Once the capture capacity of these materials is reached they can be renewed by drying at a high temperature. The odor capture measurements of the textile products are generally determined by the purity, size and amount of used absorber [7].

— Stop the Growth of Microorganisms (Active Approach)

This technique measuring the textiles ability to hinder or reduce the growth of bacteria (biostatic) or to kill surface applied bacteria (biocidal) [8]. Controlling microbial growth reins the cause of most textile odors that is unwanted bacterial growth. This lesson the formation of biofilms of bacteria on textiles that ensure the more comfort and also controlled the odors.

Silver and nano-silver are worked on this basis of technique that reduces the occurrence of unpleasant body odors and other unpleasant smells by inhibiting the replica of bacteria, mites and fungi that cause odors [9]. This confirms that textiles remain hygienically fresh.

ANTI-ODORANT AGENT

— Natural anti odorant material

Bamboo fabrics are factory-made from the fibers, which is converted to fiber from the stalks. It is regarded as an eco-friendly substantial because of its remarkable attributes.

It is environmentally friendly and can be considered as a possible substitute of conventional cotton fibers. Bamboo fibers are 100 percent biodegradable. It withdraws moisture away from the body so that it can evaporate easily. It also diminishes the bad odor in the wearing material. This fabric is anti-static and holds to the skin in a perfect way.

It is a perfect type of clothing for people who are prone to skin problems and allergies [10]. Which can be extensively used as sanitary clothing for its anti-odorant and anti-bacterial properties. Not only has that it also avoided skin problems and allergies [11] along with reduction of bacterial multiplications.

— Chemically anti odorant materials

Over the decades, new technologies have emerged which hold the potential of delivering more effective protection against odor in clothing. Most anti-odor technologies for clothing are based on chemical treatments. Things such as zeolite, engineered polymers, cyclodextrine, activated carbon and silver are the chemically anti odorant agent.

— Zeolite

Anti-odor technology binds the power of Zeolites are mineral-based substances originating from volcanic ash that have the power of binding odorous material and keep products smelling fresh. Enormous surface area of zeolite carriers entices and adsorb odor molecules on products. These odor molecules are then released during laundering, after which the technology regenerates. Next-generation equipment of zeolite not only attracts and adsorbs odor molecules, but also degrades them. This enables self-regeneration of the technology without laundering [12].

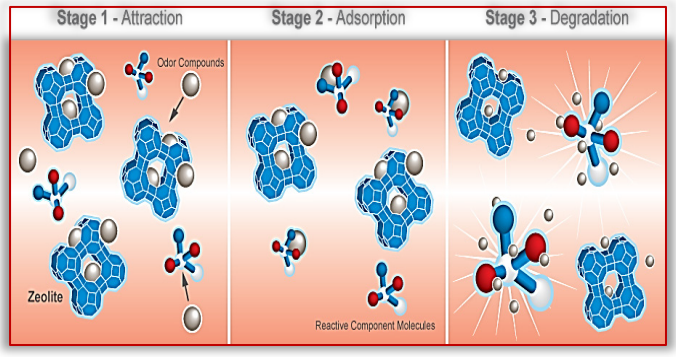

Figure. 5 Mechanism of zeolite in case of anti-odor finishing

— **Engineered Polymers**

Engineered polymer is one kind of resin that traps human odors. It is a synthetic material, which is fused to the fabric particularly in the scent blocker garments, contains macro pores that provide a large surface area for human odor molecules to enter and micro pores to trap them.

— **Cyclodextrin**

The cyclodextrins (also called Schardinger dextrin, cycloglucose, cycloamylose, cycloglucoamylose) are non-reducing cyclical oligo- saccharin, consisting of 6 to 12 (sometimes even 26) α- D (+)-glucopyranosic groups bound to α-1,4 glycosidic [13]. Which has a cone trunk structure with a cavity in its center, inside part of the cone is hydrophobic and outside portion are hydrophilic. Cyclodextrins contain several number of glucose units in its structure. The common cyclodextrins contain 6,7 and 8 number glucose units to form α-CD, β-CD and γ-CD respectively.

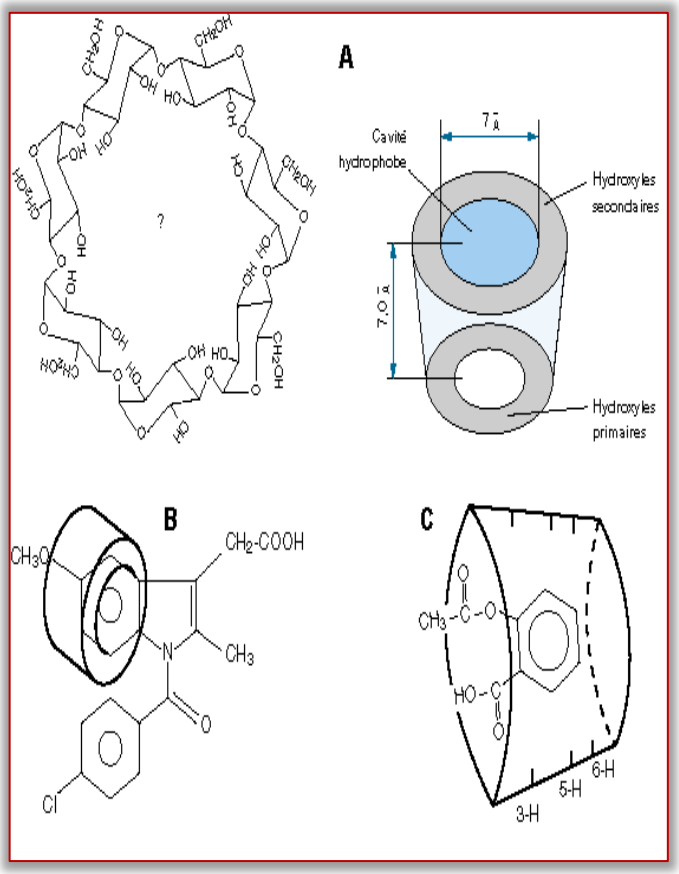

Figure 6. Structure of cyclodextrin

— **Odor controlling mechanism of Cyclodextrin**

The cyclodextrins are synthesized by enzymatic degradation of starch, maize and corn. All the hydroxyl groups in the cyclodextrins are oriented to the outside of the ring, while the glucosidal oxygen and two rings of the non-exchangeable hydrogen atoms are directed towards the interior of the cavity. This combination gives cyclodextrins a hydrophobic inner cavity and hydrophilic exterior. The hydrophobic inner cavity provides the capacity to form inclusion complex with a variety of guest molecules such as aromatics, alcohols, fatty acid and esters. The hydroxyl group can link with cross-linking agent, which can provide strong linkage with hydroxyl group of textile material. The hydrophobic cavity of CDs can accommodate odors molecules from sweat and environment. The CDs can also be scent release finish.

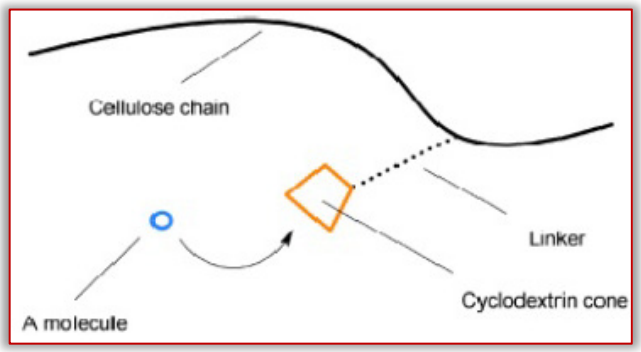

Figure 7. Cyclodextrin liking to cellulose backbone

— **Activated carbon**

The term "activated" means the carbon is treated to have a surface area that is covered with tiny pores that chemically adsorb or trap, odor molecules surrounding them. The surface of activated carbon granules is enclosed with so many microscopic pores that just one gram can have a total surface area of 500 square meters.

Activated carbon which is resulting from coconut shells, where carbon particles are modified to enhance adsorption of specific odor molecules. [14]

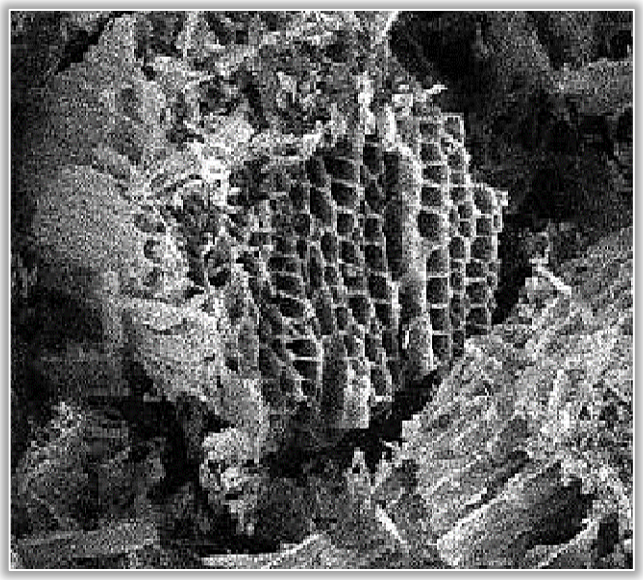

Figure 8. Activated Carbon

— **Silver**

Silver finish obstructs the growth of odor causing bacteria and provides reliable antimicrobial protection, ideal for clothing worn in everyday life, sport and travel. Improvement-silver finish is an antibacterial finishing technology using active silver ions. Silver has been known for centuries to be a

natural agent to reduce the growth of bacteria and fungus. The finish is long lasting and wash resistant. Silver particle minimize odor providing fresh feeling besides any demagogical adverse impact.

Mechanism of silver as an anti-odor finishing

- Silver ions may bind non-specifically to cell surfaces, causing some disruption to the cellular membrane function and permitting the silver ions to penetrate the microbe structure.
- Silver ions are highly reactive and readily bind to electron-donor groups, prime targets being the thiol groups (-SH) which are commonly initiate in enzymes within the microbe.
- Silver ions react with the base pairs of DNA thus preventing DNA replication of odor producing microbes [15].

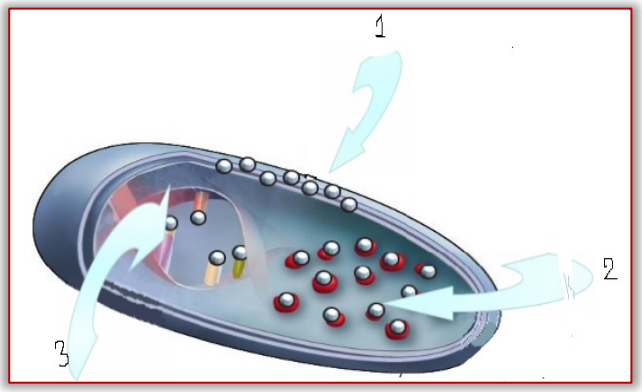

Figure 9. Working procedure of silver as anti-odor finish

- **Application methods of anti-odorant**

a) Physical incorporation of solid particle using padding technique.
b) Using cross-linking or cross-binding agents.
c) Chemical bonding
d) Microencapsulation.

Physical incorporation of solid particle using padding technique

The vast majority of treatments for creating anti-odour textiles are applied using a dip-pad-dry-cure process. This process is used to the textiles in roll format before construction of the garment or product. Complex chemical formulations are used, which not only contain the chemicals obligatory on the textile.

Using cross-linking or cross-binding agents

This method depositing of anti-odorant particles into the textiles substrate and permanently binding the of solid particles to the textile product such that it enhances the anti-odorant performance of the textile materials.

Chemical bonding/chemical treatment

Most anti-odor technologies have relied on chemical treatments with their antimicrobial component.

Microencapsulation Method

Microencapsulation is one of the novel methods of accomplishment functional finishes on textiles. The anti-odorant agents reside in colloidal suspension with the amorphous zone of the polymeric binder so that a reservoir of agent is present in solid/ solution within the polymer matrix.

TEST METHOD FOR DETERMINATION OF ANTI-ODORANT FINISHING

Efficacy against odor producing bacteria

Based on the standard test method DIN EN ISO 20743 (Determination of anti-bacterial activity of anti-bacterial finished product) the antibacterial activity is quantitatively tested against the skin specific microbes of the genera staphylococcus and Corynebacterium after 4 hours of incubation. [11]

Binding capacity of fabrics for sweat odor molecules

A special sweat odor stimulates (artificial sweat), which contains radioactively labeled lead substance of odors sweat, is applied on the sample under defined conditions of temperature and humidity. After an incubation period, remaining odor molecules in the fabrics are quantified.

Odor field tested:

Samples are worn by five test persons in an application specific activity. Odor intensify is then evaluated in comparison to a reference fabric. The field test can thus prove an anti-odor effect from the consumer's point of view and compromises the sum effect of al modes of action for example an improvement of ventilation effects, anti-odor finishing and construction effect [16].

APPLICATION AREA OF ANTI-ODOR FINISHING TEXTILES

Clothing with anti-odor properties is one of the fastest emergent segments of the performance of today's textile sector. Which dazzling the desire of consumers for hygiene, freshness and a general sense of well-being particularly in certain apparel categories such as:

For clothing section

In sportwear, outdoor garments, partywear, socks and footwear and intimate garments.

In case of home & hospitality industry

In fitted bed sheets, pillows cover and duvets, bathroom textiles, terry towels, table cloth, curtains and other upholstery items.

In healthcare Industry

Finishes can be applied in bed Sheets, doctor aprons and patient apparels.

COMMERCIAL EEXAMPLES OF ANTI-ODOR FINISHED FABRIC

SmartSilver™

SmartSilver is developed and produced by Nano Horizons Inc. entirely in the USA and is commercially used in the textile, health care, coatings, and plastic industries. SmartSilver is a global brand that optimize the natural anti-odor properties of silver through

superior chemistry. SmartSilver additives can be applied at the molecular level into natural and synthetic fibers and fabrics, coatings, foams and polymer applications to provide antimicrobial protection against odor-causing bacteria that lasts the expected life of the product. The active ingredient in Smart Silver is EPA registered and is certified as being free of harmful substances according to the Oeko-Tex® 100 standard [17].

SPORTINGTEX ®

SPORTINGTEX ® is a knitted fabric which provide deodorant properties of fabric. The main application of this fabrics, such as Sports Wear, Casual Wear, Outdoor Wear and Accessories etc. The main feature of this cloths is preventing the evolution of bacteria & mildew that may cause itching and unpleasant odor, safety and durability and washable, without dropping its performance after many times washing. Maintain hygiene & comfort to the human body [18].

CAVATEX

CAVATEX is fabric under the manufacture of Germany who produce cyclodextrin coated finished fabric which can capture odors and release active ingredients in cycles, which are refreshed through washing.

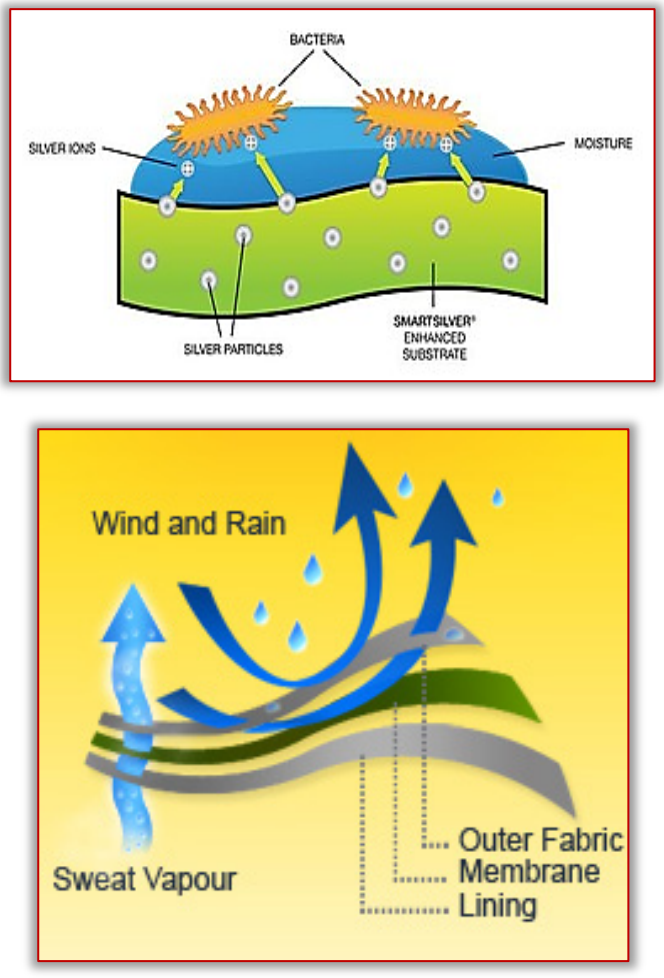

Figure 10. Commercial anti-odor finished clothes (Left: SmartSliver Right: SPORTINGTEX)

CONCLUSION

Anti-odorant molecules in textiles control the growth of odor-causing bacteria arising in clothing that are used as daily basis. Normally these bacteria would generate unpleasant odor, but by controlling their growth, treating with suitable chemicals, prevents the formation of these odors and keeps fabrics fresher longer. More specifically, these chemicals can be applied at the manufacturing level which create bonds into fabric or just bind with fabric by coating. It then kills bacteria by puncturing their cell membranes.

Once the bacteria are dead they can no longer produce any kind of noisome smell that enable fabrics to ascertain their freshness. By following the odor resisting technique many commercial manufacturers produced especially sportswear or children wear that are adorable and highly acceptable to consumers.

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