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Types of Fibers Used in Non-Implantable Medical Textile and their Applications

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ABSTRACT
Medical textiles have become an emerging sector in the technical textile market. The medical industry is persistently achieving novel production practices to develop high quality products in a biodegradable and eco-friendly way. The key factors of medical textiles are non-toxic, biologically compatible, high strength, resistant to allergens and cancer, comfort, antifungal and antimicrobial performance. The recent development in medical textile had made the hardest and painful days of the sufferers to snug days. Non-implantable materials are used on external applications of the body. It may or may not be in contact with the skin .These materials are used in diverse field such as products for wound ease, adhesive bandages ,protective eye pads ,plasters, surgical gowns, padding material, orthopaedic support belts, bandages etc. This article discusses the significance of Fibers used in implantable medical textiles products and their applications.

KEY WORDS: Medical Textiles, Non-Implantable Materials, Bandages

1. INTRODUCTION

The term "medical textile" refers to textiles specifically designed for medical use. Globally, the textile industry plays a vital role in healthcare and hygiene sectors. Healthcare materials utilised diverse textiles such as yarns, knits, non-wovens , wovens, braids and composites.[1] Medical textiles are a dynamic research area within technical textiles, showcasing diverse applications. These textiles are designed for medical use, including implantable, non-implantable, and external applications, such as wound care, tissue engineering, and organ regeneration. Key characteristics of healthcare textiles include non-toxicity, durability, biocompatibility, and biodegradability, as well as excellent absorbency, softness, and purity without additives or contaminants. Textile materials, combined with scientific techniques, are widely used in medical and surgical applications due to their robustness, adaptability, ease of use, and antimicrobial properties. Healthcare products are primarily made from yarns composed of multiple filaments or single filaments, using techniques such as knitting, nonwoven, woven, braiding, and composite structures.
The growth of medical textiles is driven by factors such as absorbency, flexibility, softness, durability,

non-toxicity, and biocompatibility. Implantable textiles, like fibres and fabrics, facilitate effective body repair, while non-implantable materials are used in external applications, requiring properties like non-allergenicity, antimicrobial resistance, breathability, and sterilizability.

2. MATERIALS AND METHODS

2.1 NON-IMPLANTABLE MEDICAL TEXTILE

Non-implantable medical products play a crucial role in wound care by providing a protective barrier against infection, absorbing blood and fluids, and fostering a conducive environment for healing. These products are designed for external use, catering to various bodily surfaces that require surface-level wound management and treatment. It generally consists of the following properties mentioned below.

- Durability refers to the capability to endure repeated use and washing without affecting the structural integrity.
- Comfort involves providing a pleasant and non-irritating sensation on the skin for prolonged wear.
- Breathability allows for adequate airflow to prevent overheating and enhance comfort. Moisture Management involves efficient absorption and wicking properties to handle perspiration and moisture effectively.[7]
- Antimicrobial Properties ensure resistance to microbial growth, maintaining hygiene and reducing infection risks.
- Chemical Resistance protects against exposure to various chemicals and cleaning agents without deterioration.
- Colour Stability ensures the preservation of colour integrity over time and after multiple washes.
- Non-Allergenic properties minimize the risk of allergic reactions or skin sensitivities.
- Easy Cleaning and Sterilization capabilities enable simple cleaning and sterilization to meet medical hygiene standards.
- Tear Resistance involves withstanding wear and tear from regular use without compromising functionality.
- Flexibility allows for freedom of movement without constraining the wearer. Cost-Effectiveness balances performance with cost considerations for widespread use in healthcare settings.
- Regulatory Compliance involves meeting relevant safety and quality standards set by regulatory authorities in the healthcare industry.

2.2 TYPES OF FIBRES USED

Non-implantable materials are utilized for external body applications and are not meant to be inserted inside the body. These materials serve to protect against infections, absorb bodily fluids, and sometimes deliver medications for postoperative care. Examples of such materials include wound dressings, bandages, orthopaedic supports, and pressure garments. Various textile fibres like cotton, silk, viscose, lyocell, collagen, polyester, polyamide, and polypropylene can be employed in the production of these materials.

APPLICATION	TYPES OF TEXTILE MATERIALS	TYPES OF FIBERS
Plasters	Woven, Knitted, Non-woven	Viscose, Polyester, Lyocell, Cotton, Polypropylene

Absorbent pad	Non-woven	Cotton, Lyocell , Viscose
Base material	Non-woven, Woven	Viscose ,Lyocell ,Cotton , Polyamide fibre
High support bandages	Woven, Knitted, Non-woven	Cotton ,Viscose ,Lyocell ,Elastomeric fibre yarns
Simple non-elastic and elastic bandages	Woven, Non-woven, Knitted	Cotton ,Viscose ,Lyocell ,Elastomeric fibre yarns
Orthopaedic bandages	Woven, Non-woven	Cotton ,Viscose , Lyocell ,Polyester,
Compression bandages	Woven , Knitted	Cotton ,viscose ,Lyocell , Polyester ,Elastomeric fibre yarn
Wound contact layer	Woven ,non-woven, knitted	Alginate fibre ,Chitosan ,Silk, Viscose ,Lyocell , Cotton.
Gauze dressing	Woven ,Knitted, Non-woven	Cotton ,Viscose ,Lyocell ,Alginate fibre ,Chitosan
Lint	Non-woven	Cotton
Wadding	Non-woven	Viscose, Cotton, Linters , Wood pulp
Scaffold	Needle punch non-woven	Polylactide ,Polyglycolide ,Carbon fibre

Table 1 Materials used in Non-implantable materials [4,8]

2.3 APPLICATIONS

2.3.1 PLASTERS

Fabric plasters are highly flexible and breathable strips designed for treating minor injuries, such as scrapes, blisters, and small wounds. They are also used to cover injection sites during vaccinations or blood sampling. The stretchy material conforms to the skin's movements, making them ideal for use on joints and other mobile areas of the body.

2.3.2 GAUZE

Medical gauze, a widely used wound care dressing, is a versatile fabric employed in bandages, dressings, and surgical sponges. Gauze is typically made from a blend of cotton, rayon, polyester, or other fibres. Woven gauze features an open weave that allows for effective fluid absorption, wicking, and transfer to other absorbent materials in the dressing.

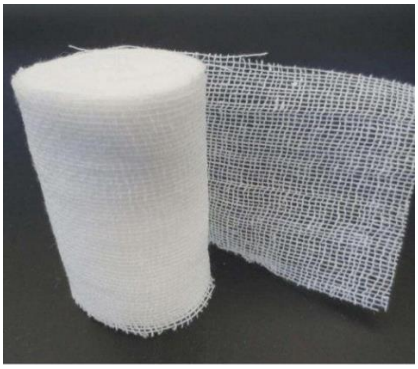

Figure 1 Gauze

In contrast, nonwoven gauze is constructed by pressing fibres together to mimic a weave. This design enhances wicking capabilities and absorbency while minimizing lint and reducing the risk of leaving fibres

behind in the wound when removed. non-woven gauze offers improved performance compared to traditional woven gauze.

2.3.3. BANDAGES

Bandages are textile products designed to support and protect wounds, facilitating the recovery process. They can be used to secure wound care layers in place or as a standalone solution for orthopaedic applications, such as crepe bandages. Additionally, adhesive wound care products are available for convenient use. Their primary function is to hold the dressing of the wound firmly to prevent moving.[5,6]

2.3.4. COMPRESSION BANDAGES

Compression bandages are specifically designed to manage swelling and provide support for new injuries or inflammation. They are particularly effective in treating venous leg ulcers and reducing leg swelling. By applying graduated pressure, compression bandaging promotes healing for specific types of ulcerations.

Leg ulcers occur when the skin breaks, allowing bacteria to enter the underlying tissue, often caused by vein disease. Prolonged periods of sitting can lead to blood clots in deep veins, increasing the risk of ulcer formation.

Compression bandages address this issue by applying targeted pressure to control and reduce swelling, facilitating the healing process for venous leg ulcers.

2.3.5. WOUND CARE

There is a variety of dressings available for different medical and surgical needs. Wound dressings serve several functions such as protecting against infections, absorbing blood and fluids, aiding in healing, maintaining wound smoothness, and delivering medications to the wound. It is essential for the wound contact layer to prevent the dressing from sticking to the wound and be easily removable without disturbing new tissue growth. Gauge and paraffin-coated gauge are commonly used dressings, typically made from cotton in a loose plain weave.[2, 3] Changing dressings for burns and skin graft sites regularly is crucial to prevent pain and tissue damage, which can delay healing and increase the risk of infection. Nonwoven fabrics offer advantages like improved sterilization, smoothness, and lint-free properties, enhanced softness and absorbency, and specialized structures for post-operative care and burn wound dressings. These dressings play a vital role in providing a physical barrier for wounds and offer benefits such as fluid control, odour management, microbial control, and accelerating wound healing.

2.3.6. WADDING

Wadding serves as an insulating layer between fabrics, commonly found in quilt crafting. Various wadding options include cotton, wool, polyester, cotton/poly blends, and even fusible batting.

Figure 2 Wadding

2.3.7. LINT

Lint is a soft, fleecy material used in medicine for dressings and poultices on wounds. It can be made from linen that's been scraped until it's soft and woolly, or from a cotton substitute. Lint is usually fluffy on one side and smooth on the other. It's an effective first aid dressing, and is often used over a primary dressing on wounds that are exuding fluid.

3. RESULTS AND DISCUSSIONS

In medical applications, various textile materials are employed, including fibres, yarns, fabrics, and composites. The use of synthetic fibres is prevalent in the production of these items. Medical textiles need to meet specific requirements such as absorbency, strength, flexibility, softness, and sometimes bio-stability or biodegradability, depending on the intended use. The fibres utilized in the medical field range from natural options like cotton, silk, and regenerated wood fluff (for absorbency) to synthetic fibres like polyester, polyamide, polyethylene, and even glass. These materials are crafted into woven, non-woven, and knitted textiles. Cotton and viscose are particularly important in non-implantable medical textiles.

4. CONCLUSION

The medical textiles sector is a vital subcategory of technical textiles, encompassing a broad range of products, from disposable items like diapers and sanitary pads to sophisticated organs and devices for blood filtration, prosthetics, and orthopaedic aids. The primary characteristic of medical textiles is their ability to fulfil their intended purpose.

The medical textiles industry is rapidly expanding, driven by continuous innovation in smart technologies. Breakthroughs in intelligent textiles offer opportunities to create medical textiles with enhanced functional characteristics and enable the development of new, active medical textiles. Advances in textile technology have led to the development of various non-woven, knitted, and woven textiles, which are increasingly being used in medical procedures. These textiles will be utilized in all extracorporeal devices, external or implanted materials, and healthcare and hygienic products. textiles.

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