Healthcare and Hygiene Products Application in Medical Textile

Ramratan Guru, Anupam Kumar and Rohit Kumar

Abstract

Healthcare and hygiene products are usually available over the counter and normally used for hygienic purposes to prevent infection and transmission of diseases, provide hygiene, and enhance care in the hospital ward and operating room. Nowadays it is a scientific research approach to big growing part in medical textiles, in healthcare and hygiene products. The day by day increase in demand of medical textile in different sectors like wipe to operating rooms are more advanced fabrics used with anti-fungal and anti-microbial applications. In this sector, new concepts of low-cost effective techniques are developing day by day for both patient and hospital staff to protect them from the effect of virus infection and other bacteria. This paper basically discusses the main role of hygiene and health care sectors application in medical textile.

Keywords: healthcare and hygiene products, design materials, product application and testing

1. Introduction

An important and growing part of the textile industry is the medical and related healthcare and hygiene sectors. The extent of growth is due to constant improvement and innovations in both textile technology and medical procedures. A critical and developing part of the fabric Industry is the clinical and associated healthcare and hygiene sectors. Textile has usually been part of healthcare [1]. The variety of merchandise to be had is sizeable however normally they are used inside the running room theatre or at the health centre ward for the hygiene, care and protection of personnel and patients. The range of programmes variety from the easy cleansing wipe to the superior barrier fabric used for running rooms. Medical textiles constitute systems designed and executed for scientific software [2]. The range of programs is diverse, starting from an unmarried thread suture to the complicated composite systems for bone alternative and from the easy cleansing wipe to superior barrier fabric utilized in running rooms. Textile substances and products, which have been engineered to fulfil precise needs, are appropriate for any scientific and surgical software wherein a mixture of strength, flexibility and from time to time moisture and air permeability is required.

Textile materials and products that have been engineered to meet particular needs are suitable for any medical and surgical applications, where a combination of strength, flexibility and sometimes moisture and air permeability are required [3, 4].
2. Constituent element of medical textile products

3. Healthcare and hygiene products

Textile has usually been a part of healthcare. The variety of merchandise to be had is sizeable; however, normally they may be used inside the working room theatre or at the health facility ward for the hygiene, care and protection of workforce and patients. The quantity of packages variety from the easy cleansing wipes to the superior barrier fabric used for working rooms [5].

The medical textile fabric merchandise may be prepared into three simple categories

- Patient specific: sponges, sheets, burn sheets etc.
- General patient management: Under-pads, adult diapers and wipes
- Procedure specific: sterilization wrap, surgical gowns, drapes, table covers, face masks, head and shoe covers.

4. Characteristics of materials for medical use

- Nontoxicity
- Non-allergenic response
- The ability to be sterilized
- Elasticity, durability
• Biocompatibility

• Fast and highly absorbent

• Static dissipation

• Antimicrobial

Wide range of staple fibres are used for the hygiene sector and technical application (Table 1)

• Bi-component fibres for thermal bonding, used in hygiene articles such as sanitary napkins, baby diapers, etc.

• Special types for hydro-entangled nonwovens are not only employed in the manufacturer of wet and cosmetic wipes but also increasingly in technical applications.

• Fibres made from biopolymers (PLA/Ingeo) include fibres made from renewable plant compounds

• Fill fibres for beds.

Non-woven possesses the following properties due to which they became famous in medical field:

• Various parameters can be controlled easily like porosity, weight of fabric, thickness.

• Nonwovens are easy to sterilise

<table>
<thead>
<tr>
<th>Used medical application</th>
<th>Type of fibre used</th>
<th>Cloth type</th>
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<tr>
<td>Cover cloths and Surgical drapes</td>
<td>Polyester and polyethylene</td>
<td>Nonwoven or woven</td>
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<tr>
<td>Absorbent layer</td>
<td>Polyester, polypropylene</td>
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<td>Outer layer, Incontinence and diaper</td>
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<td>Surgical hosiery garments products</td>
<td>Polyamide, polyester, cotton and elastomeric yarn</td>
<td>Nonwoven and Knitted</td>
</tr>
<tr>
<td>Wipes and garments</td>
<td>Viscose rayon</td>
<td>Nonwoven</td>
</tr>
<tr>
<td>Masks and caps etc.</td>
<td>Viscose rayon, polyester, viscose and glass</td>
<td>Nonwoven</td>
</tr>
<tr>
<td>Pillow covers, sheets and Bedding, Blanket</td>
<td>Cotton, polyester and cotton</td>
<td>Woven and knitted</td>
</tr>
<tr>
<td>Surgical gowns garments</td>
<td>Cotton, polyester, viscose rayon and polypropylene</td>
<td>Nonwoven and Woven</td>
</tr>
</tbody>
</table>

Table 1. Product applications [2–6].
• Various manufacturing technique options according to applications.

• Economical manufacturing process.

5. Textile materials used in operating theatre and emergency rooms

These encompass surgeon’s gowns, caps and masks, affected person drapes and cowl cloths of all sizes. The reason for defensive healthcare clothes is to defend healthcare experts from infection from blood and different infectious fluids [6, 7]. Biological defensive clothes are described through the Occupational Safety and Health Administration (OSHA) as follows: ‘Personal defensive garb may be taken into consideration suitable most effective if it does now no longer allow blood and different infectious substances to by skip thru to attain an employee’s paintings clothes, road clothes, undergarment, pores and skin, eyes, mouth or different mucous membranes below the ordinary situations of use and at some point of time the protection system may be used’. According to this definition, there are fundamental necessities for a defensive fabric garment: it ought to save you infectious substances from passing thru the pores and skin and it ought to closing lengthy enough. Protective clothing inside the clinical subject ought to be affordable, breathable, comfortable, dependable, and effective [8].

6. Design issue

Main issue in design and use of operating room fabric used to be is the protection of the patient from contamination by the environment and by healthcare workers. The principle design features for medical non-woven fabric are barrier properties, strength, sterilization stability, breathability and comfort for garment application.

6.1 Barrier performance

Barrier performance can be partial (resistant) or total (proof) ranging from particulates and bacteria to fluids and viruses. The principal necessities for barrier fabric are that they withstand the penetration of liquids, especially blood and on the equal time be sterile, breathable, bendy and cheaper. Because of those necessities, maximum of the barrier clothes are crafted from non-woven fabric, which can be exceedingly cheaper and may be thrown away after every use, hence lowering the want for re-sterilization. In a few cases, unique breathable movies are being brought to fibres and fabric. In different cases, components are being brought without delay into polymers getting used to making the fibres. Theatre drapes are meant to shape a barrier in opposition to contamination each to and more good from the patient. Strength requirements vary with end-use application. For surgical drapes, stiffness is very critical because barrier performance may be affected by comorbidity to patient or equipment. Good abrasion resistance is necessary for the safety of barrier administration. The consumer product safety commissions (CPSC) require 3.5sec burn time on CS-191-53 for gowns, head covering and surgical mask [9–11].

6.2 Sterilization stability

Many hospitals have delivered peroxide plasma systems, inclusive of STERRAD, to their steam autoclaves and ethylene oxide chambers inside the Central Supply Room.
In designing fabric for sterilization, it is far critical to apprehend the effect of sterilization tactics on material overall performance features. Steam autoclaves typically function at 132°C. Fabrics containing cellulose are not typically advocated for the plasma gadgets as those fabrics hold residual peroxide.

6.3 Comfort and breathability

The consolation and breathability components are commonly taken into consideration as opposing the barrier performance. For sterilization wrap, the difficulty is that the barrier should save you dirt and micro-organisms from penetrating a sterilized bundle in the course of garage and transportation. At an equal time, it should be porous sufficient for the sterilant to penetrate the wrapped bundle and absolutely sterilize the content material of the surgical set.

6.4 Linting

For gowns, linting is not wanted because particles from gowns or drapes may complicate the wound healing process. In general, it is accepted that particles above 50μm are readily visible to the unaided eye.

6.5 Antimicrobial textiles

Treated fabric articles can encompass clinical textiles consisting of pads, face masks, surgical gowns, ambulance blankets, stretchers, and clear out substances and diapers [12].

6.6 Antimicrobial fibres

High overall performance fibres had been evolved which save you risky microorganism from buildup and could discover programs with inside the fields of private hygiene wherein buildup of risky microorganism may be risky to health: the fibre essentially includes a mixture of antimicrobial compounds, primarily based totally on steel salts which in the end controls microorganism and fungi. The compounds are embedded inside the matrix of fibres which renders it impervious to washing and wear [13].

7. Product application

7.1 Surgical gowns

Surgical gowns are worn during medical procedures, to prevent contamination by splattering of body fluids such as blood, respiratory secretions, vomit or feces during medical procedures.

Surgical gowns are made of fluid-resistant materials to reduce the transfer of body fluids (Figure 1). Isolation gowns are usually intended to protect the wearer from the transfer of micro-organisms and only small amount of body fluids [14].

7.2 Surgical masks

They should have high level of air permeability, high filter capacity, and should be light weight and non-allergic.
Materials: consist of a very fine middle layer of extra fine glass fibres or synthetic micro fibres covered on both sides by either an acrylic bonded parallel-laid or wet-laid non-woven (Figure 2).

7.3 Surgical drapes and cover cloths

These are used to cover patients or working areas around patients.

Material: loop raised warp-knitted polyester fabric laminated with PTFE films for air permeability, comfort and resistance to microbiological contaminants [15].

7.4 Surgical hosiery

Surgical hosiery with graduated compression traits is used for wide variety of purposes, starting from a mild help for the limb to the remedy of venous disorders. Knee and elbow caps, which might be commonly fashioned throughout knitting on round machines and might additionally comprise elastomeric threads are worn for help and compression throughout bodily energetic sports activities or for protection.
7.5 Hospital ward textiles

Such as bedding garb, bed covers, incontinence merchandise are used for care and hygiene of patients. The conventional Woollen blankets had been changed with cotton leno woven blankets to lessen the threat of pass contamination and are crafted from smooth spun two-fold yarns which own suited thermal qualities. In isolation wards and in-depth care units, disposable defensive garb is worn to reduce pass contamination and are made from composite of tissue strengthened with a PET or polypropylene spunlaid web [16].

7.6 Cleaning products

These include gauze for floors, dry dusting systems; hard surface disinfectant wipes high absorbency cloth, window cloth, electrostatic disposable dusters, cleaning mop, etc.

8. Absorbent hygiene products

8.1 Modern breathable disposable feminine products

Figure 3 classify of three layers:

- Inner pinnacle layer: fabricated from a mix of hydrophobic low-density fibre and is liquid and water permeable.
- Core layer: full of wooden pulp and different absorbent fabric is especially absorbent.
- Third layer encompasses multi-layer barrier, this is water vapour permeable, however persistent to liquid water.

8.2 Modern incontinence product

Modern incontinence product also consists of three layers. Cover stock that is permeable and diffuses liquid laterally. Highly absorbent core and barrier polyethylene or PVC films that help patient cloths or bedding to keep dry.

Figure 3.
Modern breathable disposable feminine products [16, 17].
9. Testing of healthcare garments

Laboratory exams consist of water repellency, launder ability, burst electricity and tear electricity. The layout of barrier fabric is pushed with the aid of using the priority over HIV. Therefore, for those fabric check techniques that might help with inside the Characterisation of merchandise as blood-resistant, blood-evidence or viral evidence. These techniques were installed as ASTM 1670-95 and 1671-97.

The call for wettability approach of measuring the absorbency traits of fabric was defined with the aid of using Lichstein. This method measures each capability and absorption price concurrently at zero hydrostatic head. It is relevant to distinctive absorbents, wicking fluids and more than one ply system with the absorbent at any attitude to the fluid and below distinctive pressure [17].

10. Advanced medical textiles

Bio-purposeful substances are starting up new opportunities for the medical fabric sector. Here energetic materials are included in the fibre with the aid of using chemical change or implemented onto the fibre floor at some point of the spinning process. These components are transferred to the pores and skin with the aid of using frame moisture and frame warmth with stepped forward bioclimatic and hygienic homes such as.

- Protection to the pores and skin from liquids, debris and bacteria.
- Providing a powerful barrier towards germs, fungi and danger of infection.
- Thermo regularity characteristic.
- Ease of laundering, sterilization and anti-static behaviour
- Low stage of fabric chemical compounds and dyes with excessive mechanical stability.

New fabric is evolved to face up to bacteria, mildew, stain and odour for healthcare applications. For example, anti-allergen completing retailers are used on material to offer themselves remedy to sufferers from bronchial allergies and allergic reactions as a result of dirt mites.

Active substances can also be made available to the skin as an aqueous solution by micro-encapsulation or by their insertion into water-absorbing network polymers, which are affixed to the fibre. Advanced processes also offer the potential for the development of bioactive, drug-delivering textiles and the controlled treatment of diseases.

11. The functional requirement of bedding material for elderly patients

Ideal bedding materials attribute the following

- Convenient during changing and to wash
- Breathable
• Absorbent
• Durable
• Odour free
• Now allergic
• Hygienic
• Easy to care for and store
• Prevent liquid and soil spread around
• Colour and pattern of the fabric (not significant for elderly)
• Provide comfort support
• Keep patient clean after being soiled
• Smooth to the touch
• Keep patient warm after being wetted
• Soft to touch dry after being wetted

12. Conclusions

The application of textile in high performance and specialized fields are increasing day by day. There will be an increasing role for medical textiles in future.

• Textile substances hold to serve a critical characteristic with inside the improvement of number clinical and surgical products.

• The advent of recent substances, the development in manufacturing strategies and fibre properties, and the usage of greater correct and complete trying out have all had a giant impact on advancing fibres and fabric for clinical applications.

• Advances in nonwovens have ended in a brand new breed of clinical textiles. Advanced composite material containing a combination of fibres and fabrics has been developed for applications where biocompatibility and strength are required.

• As medical procedures continue to develop, the demand for textile material is bound to grow.
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