

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Woven, knitted, and nonwoven textiles are the most common types of textiles. These textiles are typically formed of yarns and/or fibres. Technical textiles are textile materials and goods used primarily for their technical performance and functional properties, rather than their aesthetic or decorative qualities [1]. Additionally, the technical textiles are becoming an increasingly essential component of the textile industry for applications that go beyond textiles. This clear definition allows for much room for interpretation, particularly as more textile items are increasingly integrating both performance and decorative attributes and functions to an equal extent. Technical textiles are much more important to society and economy in many ways than just the conventional textile business of textile industry. This sector of the industry is experiencing rapid growth within the textile industry [2].

One of the wide varieties of technical textile goods includes medical textiles, which constitute an important part of the spectrum. A type of technical textiles that provide medicinal functional properties for improving their technical performance infusing the behaviour of aesthetic (or) decorative is known as Medical Textiles [3]. They encompass both mass-produced disposable items like baby diapers, feminine hygiene products, and adult incontinence products, as well as highly specialised and valuable textile products used as blood vessels for dialysis performing the kidney's function, surgical sutures, prostheses, and more recently, scaffolds for tissue regeneration. These are used in a medical context for the goal of treating injuries or producing conditions that are ideal for the medical care of wounds or illnesses. They cover all textile materials used in general healthcare and personnel hygiene applications.

## 1.2 Classification of Medical Textiles

The various end-use applications of textile materials used in medical and healthcare industries may be broadly classified in to four subdivisions [4].

- **Implantable:** Sutures, heart valves, vascular grafts, artificial veins, artificial tendons and ligaments, artificial joints and bones, artificial skin, and artificial cartilage are some of the things that doctors put into human's body, either temporarily or forever.
- **Non-implantable:** Non-implantable textiles are safe to use topically, but they are never inserted into the body. Non-implantable materials include gauze, surgical dressings, and bandages, to name a few. In simple terms, non-implantable textile materials come into direct contact with an injured body portion without being inserted in body or being absorbed by the body.
- **Extra corporeal:** Throughout the past century, we have witnessed the advent of artificial replication and the biological production of various body components, ranging from heart rate monitors to critical internal organs. Extracorporeal organs are mechanised organs utilised for the purpose of blood purification, including procedures such as hemodialysis, hemofiltration, plasmapheresis, or extracorporeal membrane oxygenation. Advancements in modern technology have facilitated the invention of artificial kidneys, livers, and mechanical lungs [5].
- **Healthcare textiles:** Healthcare textiles are used in several applications. Ensuring adequate cleanliness is crucial in the healthcare and hygiene industries to avoid the spread of diseases, infections and to maintain the best possible health. An extensive variety of textile products are available for improving cleanliness and sanitation in both personal lives and hospitals. Disposable goods with high absorbency are utilised to collect biological fluids waste discharged ensuring the cleanliness and dryness of the skin surfaces. These items are referred to as diapers, incontinent pads or sanitary napkins depending on the individual who utilise them.

## **1.3 Properties of Medical Textiles**

Multifunctional fibre materials designed to form medical textiles especially to safely and effectively treat injuries and medical disorders. The two main types of fibres used in medical textiles usually consist of commodity and specialty fibres.

Commodity fibres are frequently produced using materials such as cotton, polyester, or nylon, and they conform to predetermined criteria. In contrast, specialty fibres exhibit a deeper level of distinctiveness. Specialty fibres, also called high-performance fibres, are designed with the goal of having a wider range of technical uses than commodity fibres. High tensile strength, thermal resistance, and chemical resistance are the three distinct qualities possessed by these limited-edition fibres, which are each designed to serve a specific application of the market segment.

These textiles are uniquely designed for medical applications, which sets them apart from other types of fabric. As such, they have some qualities that make them highly appropriate for application in this field. The unique qualities and purposes of medical textiles are frequently what define them. Medical textiles are often distinguished by their distinct characteristics and functionality.

- Non-toxic
- Non-carcinogenic
- Non-allergenic
- Fully biocompatible
- Anti-microbial

## **1.4 Anatomy and Constituents of Sanitary Napkins**

"Sanitary napkins," commonly known as sanitary pads, sanitary towels, or maxi pads, are essential to maintain reproductive organ's cleanliness in women. Sanitary napkins are disposable, single-use materials that receive, absorb, and retain menstrual fluid while receives it safely evacuating from the body surface. Unlike tampons and menstrual cups, which are inserted into the vagina, sanitary napkins are worn externally, between a woman's vulva and her undergarment. This thin structure pads absorbs the blood as and when discharged and retain for a prolonged duration during menstruating periods. Additionally, some women decide to utilize them for surgical recuperation following childbirth, abortion, or vaginal surgery. There

are wide varieties of disposable sanitary pads available in the market such as huge pregnancy pads and incredibly thin pantyliners.

The development of sanitary napkins follows a similar path to that of diapers. Making the product more efficient (more absorbent and/or less likely to leak) and/or more pleasant (softer, thinner, and dry surface) is the overarching objective of its design. Similar to a diaper, a sanitary napkin is made of multi layered structure: i) top sheet, ii) core layer, and iii) back sheet as illustrated in Fig.1.1. These generally comprises smooth plastic top sheet, bulky highly absorbent core comprising of wood fluff and super absorbent powder and barrier back sheet.

### 1.4.1 Top Sheet

Generally, the top sheet material used for sanitary pads is light weight compared to that used in diapers for new born babies and was formerly thought to have the highest absorbency [6]. A top sheet should be soft, porous, and hydrophobic in order to quickly transmit menstrual blood from the surface to the centre absorbent layer and prevent fluid backflow. Frequently, a nonwoven construction with several sub-layers and a gradient in pore size accomplishes this purpose as shown in Fig. 1.2. Additionally, it's critical that this top sheet be soft to the touch and able to withstand moisture without losing its structural integrity. Thermally fusing by hot air passage or mechanically intermingling synthetic or natural fibres using water jets can create the nonwoven sheet.

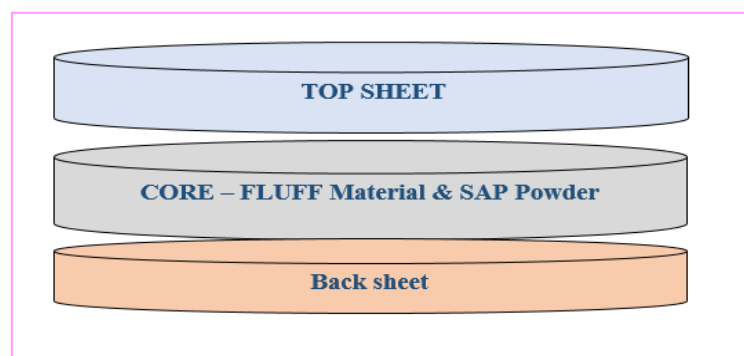


Fig. 1.1 Layer construction of disposable sanitary napkin

In order to minimize the possibility of allergic reactions when the sheet comes into contact with the skin, chemical bonding agents are typically avoided. Because a napkin's top layer manages fluid with a higher viscosity but a lesser quantity, it is typically lighter than that of diaper.

### 1.4.2 Absorbent Core

Superabsorbent polymers integrated in a cellulose matrix make up the absorbent layer. This layer is responsible for absorbing and storing the collected discharged blood [7]. Since less fluid is expected to be handled, the absorbent layer of a napkin is also thinner than that of a diaper. The napkin must also be extremely flexible to accommodate daily activities, according to the user's need [8]. This has led to a trend in which designers provide an anatomical shape to the absorbent core.

### 1.4.3 Back Sheet

The back sheet is an impermeable thin film or fabric, serving as a barrier to prevent fluid leakage. A breathable yet liquid impermeable film often composed of polyethylene [9]. The bottom part of the napkin frequently coated with a layer of adhesive to make sure the napkin stay at its designated position in undergarment.

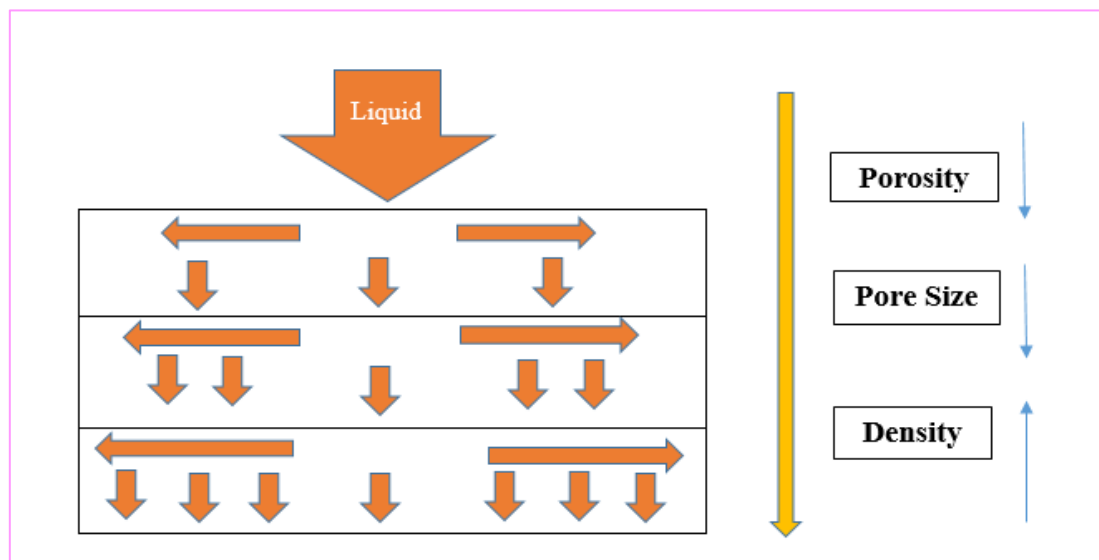


Fig. 1.2 Mechanism of fluid flow through layers of sanitary napkin

## **1.5 Rationale of Study**

Even though there had been number of studies conducted in developing and improving the hygiene products, it was found that still some more improvements are possible to extend the progress. An in-depth investigation is needed that looks into all aspects, from the raw materials to the features of finished product. Certain natural fibres waste like sisal, bagasse or bananas can be turned into absorbent materials in a number of environmentally friendly ways. The main goal of this study is to find natural materials that can be used to replace synthetic materials used the top sheet, absorbent core, and back sheet the disposable sanitary napkin that are available on the global market. Making sanitary pads more eco-friendly not only lowers their price, but also reduces cutting of trees thereby protecting natural resources and environment.

## **1.6 Aims of Study**

Unlike conventional textiles nonwoven fabric is good absorbent material for hygiene products there by helps women to stay healthy and hygienic, especially during their periods. During the menstruation there is a regular discharge of blood and mucosal tissue from the inner lining of the uterus through the vagina. Menstruation cycle repeat every 28 to 35 days from childhood until menopause phase. Most women prefer disposable pads generally made up of synthetic polymeric materials and wood fluff. The different absorbent materials used in the sanitary pads, can soak up the uterine waste. The disposed napkins have inherent problem that they don't break down naturally hence pose a threat to the environment. The quantum of this generated waste is so big that its a challenge to municipal solid waste management system to smooth functioning of cleanliness. Thus personal hygiene products that are not biodegradable have a significant impact on the environment all over the world.

Consequently, the present research endeavour has been carried out with the intention of enhancing the performance of sustainable sanitary napkins by incorporating the eco-friendly materials. The objective is to design of napkin using natural materials: cotton, silk waste, corn, and PLA nonwoven in top sheet; PBAT and PLA in back sheet; air-laid and corn starch paper with absorbent cores. And analyse the performance characteristics by comparative evaluation of their various properties.