DESIGN AND DEVELOPMENT OF SANITARY NAPKINS WITH ANTI-RASH FINISH

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

The menstrual cycle is a special characteristic of female maturity that brings both blessings and possible problems for women. The menstrual cycle will go on for about half the life of a woman, i.e. at least 2,000 to 3,000 days. Surveys have shown that 73% of the women would feel itchiness and pain on some parts of the skin during menstruation. The side effects of sanitary napkins are that if worn for more than three hours it can cause lumps on the vaginal area which might lead to irritation and other infections. Some of the microbes residing in the human vagina cause the skin infections leads to irritation, soreness, redness and swelling in the vulvar area. These are mostly caused by the use of sanitary napkins which are not air permeable and water proof..

To overcome this problem, our main aim of project work is to develop a sanitary napkin which can address this problem. We have approached the problem in 2 ways. One is to apply anti-rash finish on the Poly propylene (PP) outer cover stock of the sanitary napkins to prevent the rashes formed during menstruation. Second approach is to use Bamboo as the absorbent core of the sanitary napkins, a fiber which has antimicrobial property inherent in it.

A variety of herbal leaves with antimicrobial property were sourced and tested for their anti microbial activity. Three herbal leaves namely Thespesia populnea (Poovarasu Tree Leaves), Curcuma longa (Turmeric Leaves) and Barbados Aloe (Aloe Vera leaf) were found with better antimicrobial activity. Solutions were extracted from these leaves and were applied on the poly propylene nonwoven cover stock by means of pad-dry-cure method using a wetting agent suitable for poly propylene, one sample each for each of the herbal leaves and one sample applied with all the three herbal leaves combined (4 samples). In order to increase the functionality of the sanitary napkins additionally a chemical cool& soft finish also has been applied on the above 4 herbal finished cover stock to balance the body temperature which is generally high during the menstrual period. The impact of herbal leaves was analyzed by comparing the comfort properties of the prepared 8 cover stock samples with the 2 control samples viz; one unfinished cover stock sheet and one cool and soft finished cover stock sheet.

Curcuma longa (Turmeric Leaves) herb finished cover stock sheet was found to have better comfort properties (anti-microbial, moisture absorbency properties) than other herbs. The cover stocks with both the herbal treatment and cool & soft finish were found to have a lesser anti microbial activity when compared to that of the cover stock treated with the herbal leaves alone, but can still be used to give multiple functionalities to the cover stock. Finally 5 varieties of sanitary napkins were assembled with varying cover stock/absorbent core compositions namely unfinished PP/bamboo, unfinished PP/wood pulp, Curcuma Longa finished PP/ bamboo, cool & soft and Curcuma Longa finished PP/ bamboo and cool & soft finished PP/ bamboo. Based on comparison of we have concluded that cool & soft finished sample have good performance properties and herbal treated samples had average absorbency and good retention%.

PLATE NO	LIST OF PLATES
1	HERBALS USED
2	OPTIMIZATION OF EXTRACTED HERBAL RECIPE FOR ANTI-MICROBIAL ACTIVITY
3	QUALITATIVE STUDIES OF ANTI-MICROBIAL ACTIVITY OF POOVARASU
4	QUALITATIVE STUDIES OF ANTI-BACTERIAL ACTIVITY OF MIXED HERBAL SOLUTION
5	MACHINERIES USED FOR ANTI-MICROBIAL TESTING
6	MACHINERIES USED COMFORT PROPERTIES TESTING
7	MACHINERIES USED PHYSICAL PROPERTIES TESTING
8	MACHINERIES USED FOR SANITARY NAPKIN PREPARATION

INTRODUCTION

INTRODUCTION

The menstrual cycle is a special characteristic of female maturity that brings both blessings and possible problems for women. The menstrual cycle will go on for about half the life of a woman, i.e. at least 2,000 to 3,000 days. Surveys have shown that 73% of the women would feel itchiness and pain on some parts of the skin during menstruation. The side effects of sanitary napkins are that if worn for more than three hours it can cause lumps on the vaginal area which might lead to irritation and other infections. Some of the microbes residing in the human vagina cause the skin infections leads to irritation, soreness, redness and swelling in the vulvar area. These are mostly caused by the use of sanitary napkins.

Rashes caused by sanitary napkins are common and can be quite uncomfortable. These rashes are also known as irritant contact dermatitis caused by two bacteria: staphyloccocus aureas and group of streptococcus. Rashes also caused by the growth of microbes during menstruation and it leads to infections. The other reasons are the Fragrances and Deodorants substances are added to the sanitary product during processing. Although they can also enter the bloodstream in a similar way to the pesticides, they can also have an effect locally in the vagina and cause allergies and skin reactions. Sanitary pads are subject to chemicals in the cotton used, the bleaching process, and the use of fragrances. Although they are in less contact with the internal vaginal wall they are still in contact with the external mucous membrane and chemicals on them can enter the bloodstream this way. As such, it is of critical importance to choose suitable sanitary napkins to ensure safety during menstruation.

To overcome this problem, our main aim of project work is to develop a sanitary napkin which can address this problem. We have approached the problem in 2 ways. One is to apply anti-rash finish on the Poly propylene outer cover stock of the sanitary napkins to prevent the rashes formed during menstruation. Second approach is to use Bamboo as the absorbent core of the sanitary napkins, a fiber which has antimicrobial property inherent in it.

LITERATURE REVIEW

2. MEDICAL TEXTILES

Medical textile is one of the fastest growing sectors in technical textiles. It includes textile materials used in hygiene, health and personal care as well as surgical applications.

Medical textiles are an emerging sector of technical textiles industry and its growth is fuelled due to constant improvements in healthcare as well as innovations in the textile field.

The use of textile materials for medical and healthcare products can be classified into following main areas Barrier material (for infection control),Bandaging & pressure garment, Wound care material, Hygiene material, Implantable material ,Extra Corporal devices (like art. Kidney etc).

2.1. MEDITECH

Meditech products include textile materials used in hygiene, health and personal care as well as surgical applications. The Meditech products are available in woven, knitted and non-woven forms based on the area of application. Increasingly, synthetic fibre is being used in the production of these products. It includes products like diapers, sanitary napkins, disposables, contact lens, artificial implants, etc.

According to baseline survey of ministry of textile,meditech industry in india is projected toachieve an early growth of 9 % and the market size of sector is likely to increase to Rs 2263 crore by 2013 from the current level of Rs 1669 crore.

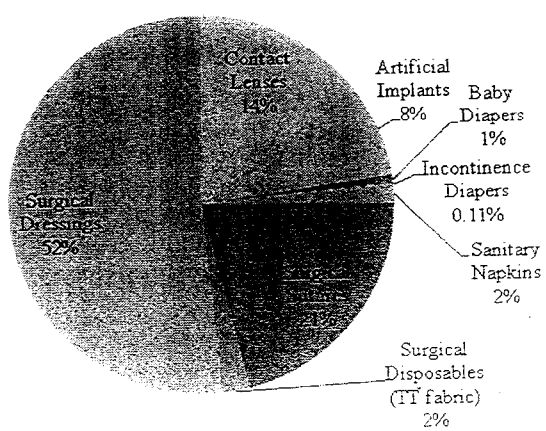


Figure 1: Value-wise share of various products in Indian Meditech market (2011-12)

The demand for Meditech products is dependent on the health and hygiene sector. The money spend on healthcare segment is steadily on the rise in India, predominantly by the private sector, which is expected to drive the demand for Meditech products. In line with these developments, Indian Meditech industry is expected to achieve a growth of 8-9% year on year, over the next three years. Medical textile market in India is estimated to be Rs 2,298 crore (FY 11) and is expected to grow at a CAGR of 20 per cent to reach Rs 5,719 crore by 2016.

The domestic consumption of technical textiles under Meditech is expected to increase from around US$ 379.4 million in 2009-10 to around US$ 488.2 million by 2012-13.Feminine hygiene napkins or sanitary napkins are a hygiene absorbent product engineered to absorb and retain body fluid during menstruation cycles, without causing any leakage. Key functions expected from a of sanitary napkin are absorbency, retention of menstrual fluid, leak proof, maintenance of aesthetic appearance, prevention of odor, comfortable to wear. They are either washable or disposables.

Disposables are widely used due to their maintenance free nature, cheaper unit price and better hygiene. They are categorized based on their absorbent capacity and design. The size of each and their content vary from market to market. Sanitary napkins consist of an absorbent pad sandwiched between two sheets of nonwoven fabric. The average woman may have as many as 400 periods in their lifetime, and can use up to 15,000 tampons during this time. This is a very large number, and it is important to consider the health implications involved in this product.

Area	Marketshare	Growth Rate
Absorbent hygiene	85%	15%
Wipes	2%	5%
Medical	6%	15%
Disposable products	1%	5%
Filtration	1%	5%
Others	5%	8%

Table 1- disposable products market in India

In India the manufacturers do not point to the composition of chemicals that is present in these products. There are no government norms to regulate these issues. Creating awareness will caution the users not to buy these products. The absorbent core of the sanitary napkin is made of wood pulp which is made by cutting numerous amounts of trees which lead to deforestation and is considered not to be eco friendly.

With an environmental commitment the objective of the study has been focused towards finding an eco friendly alternative for the wood pulp in the absorbent core of the sanitary napkins.

2.2. SANITARY PADS

A sanitary pad also known as sanitary napkin, menstrual pad, rag or maxi pad is a menstruation product used by females to absorb the blood flow during their menstruation / periods.

Sanitary Napkins or Sanitary pads is an absorbent pad of cotton, cellulose etc. worn by women during monthly menstruation or Sanitary Napkins are a disposable pad of absorbent material worn to absorb menstrual flow.

FUNCTION

Sanitary napkins are designed to absorb and retain menstrual fluid discharges. When used they are applied inside an undergarment with a press-on adhesive fixing strip.

Main functions/key elements of sanitary napkins are absorb and retain menstrual fluid, isolate fluids from the body, no leakage, no unaesthetic appearance, no odour, stay in place, comfortable to wear.

2.2.1. HISTORY OF SANITARY NAPKINS / SANITARY PADS

Sanitary napkins known as sanitary pads, sanitary towels or maxi pads, sanitary napkins are an important part of the gynecological hygiene for every woman. A sanitary napkin is a form of a porous item that has the capability of absorbing the flow of menstrual flow. Menstruating women wear them during their periods. Some women also use sanitary napkins after vaginal surgeries, childbirth or abortion. Today, there are different varieties of disposable sanitary pads available in the market, ranging from ultra-thin panty liners to oversized maternity pads. From reusable 'rags' to disposable 'napkins', menstrual pads have indeed come a long way.

Before disposable sanitary pads were created, reusable pads or cloth were widely used to collect menstrual blood. Women often used a variety of home-made menstrual pads which they crafted from various left craps, fabrics, grass, or other absorbent materials, to absorb menstrual blood. Even after disposable pads were commercially available, for several years they were too expensive for many women to afford. It took many years for disposable menstrual pads (sanitary napkins / sanitary pads) to become popular and affordable, but since then in most areas of the industrialized world their use became almost exclusive.

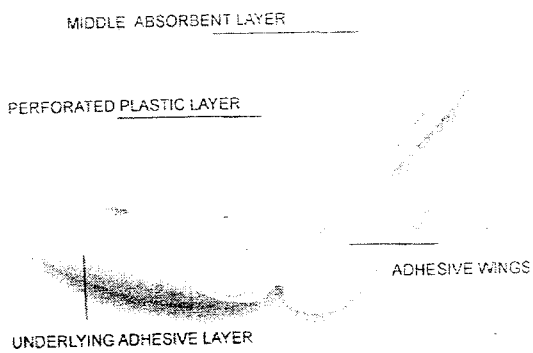
Disposable sanitary napkins/pads stared used by nurses; nurses first came up with the idea of holding the flow of menstrual blood with the help of available wood pulp bandages in the hospital. The manufacturers of bandages borrowed the idea and produced sanitary pads made from handy products that were inexpensive enough to be disposed. However, the prices of sanitary pads are very high, which made them exclusive toiletries of rich women. The first sanitary pads were in the form of a cotton wool or similar stringy rectangular structure, sheathed with an absorbent liner. The sanitary pad was shaped in such way, that it could be easily attached to a special belt or girdle.

However, due to its inconvenience, the girdle gave way to an adhesive strip on the bottom of the pad for proper attachment to the undergarment. Belted sanitary napkins became outdated and stick-on pads became popular. The belted sanitary napkin quickly became unavailable after the mid-eighties. The design of the sanitary napkins also changed through the 1980s to today. With earlier materials not being as absorbent and effective, and early pads being up to two centimeters thick, leaks were a major problem. The ergonomic designs changed over the years, for example, the Australian Libra brand initially had a pad that was wider at the front.

tapering at the back to provide a more aesthetic appearance, and the current variation now has a wide dovetail at the back, giving functionality a higher priority.

In this modern world, sanitary napkins are available in a wide variety of designed, the design of sanitary napkins taking into consideration style, comfort and fashion. Some major innovations include quilting of the lining, introduction of 'wings', fragrant pads, introduction of panty liners and reduction of pad thickness. Nowadays, most women even have their own standard sanitary brands. Besides, most brands come in very nominal prices, which have made sanitary napkins a commonplace household item.

2.2.2 STRUCTURE AND COMPOSITION



Materials used in absorbent hygiene products:

- Permeable Top cover- Polypropylene
- Impermeable Bottom cover- Polyethylene
- Absorbent core - wood Pulp
- Absorbent core – bamboo fibre
- Leak proof - Plastic film
- Adhesive- Super bond (sodium poly oxylate)

2.2.2.1 Components of sanitary napkins:

The basic anatomy of a disposable sanitary pad comp rises of an underlying layer, absorbent layer and a surface layer.

- The underlying layer is the back side of the napkin (adhesive or non-adhesive) that lies on the crotch of the panty.
- The middle layer also called the absorbent layer lies between the underlying layer and the surface layer. It is made of absorbent wood cellulose fibers. Bamboo fibres are also used as an absorbent core which has more absorbency & anti-microbial properties. The absorbent panel consist polyacrylate gel which sucks up the liquid quickly, holds it in a suspension and prevents blood leakage.

➢ An additional top layer or the surface layer sits right against the skin. It is made of perforated plastic that keeps the skin dry and acts as a barrier between the skin and the absorbent panel.

2.2.3 FACTORS TO BE CONSIDER WHEN SELECTING SUIABLE SANITARY NAPKINS (SANITARY PADS)

1. Consider different styles, brands, sizes and thickness.

The sanitary napkin needs to cover the vulva and external female genital area; the purpose is to prevent leakage. Most pad designs accommodate a size 6 panty size. Consider a plus size, extra long or overnight protection for full coverage of larger panty sizes.

2. Select a shape or design

Select shape and design based on your lifestyle. Sanitary napkins come with or without Wings and are curved or contoured to prevent leakage on the sides.

3. Consider of the absorbency rate

Think about **absorbency** and select a sanitary napkin that is very absorbent and keeps You dry and comfortable during your menstruation period. If your sanitary napkin embarrasses you by leaking then try a higher level of absorbency or a new brand. Sanitary Pad Health Threat.NoLeakSanitaryPads.com 4 Joshua Yamson

4. Thickness for comfortable

Find the **proper thickness** depend to your level of physical activities. Some prefer thick protection while others use thin pads to serve their needs without the bulkiness.

6. Air Permeable

During menstruation, the skin of the women's sensitive part is most vulnerable. Surveys shave shown that 73% of the women would feel itchiness and pain on some parts of the skin during menstruation. These are mostly caused by the use of sanitary napkins which are not air permeable. As such, it is of critical importance to choose suitable sanitary napkins to ensure

Safety during menstruation. Sanitary napkins are normally made up of three layers: surface layer, absorbent layer and underlying layer. The choice of sanitary napkins should be based on considerations relating to the materials and functions of these three layers.

7. Surface Layer Consideration

Firstly, the surface layer should preferably have a cotton net surface with rapid absorption to avoid wet skin surface. The funnel type of design is better than the bucket type of design as the discharge absorbed would not back flow easily. Some sanitary pads in the market use artificial fiber as the main material for the surface, some women will have allergic problem with artificial fiber.

8. Absorbency Layer

The middle layer should have effective absorption agents that can turn the absorbed liquid discharge into a jelly-like state so that it would not back flow when pressed and would not cause the sticky feeling. Avoid using paper pulp from recycle paper as absorbency agents, some women with sensitive will feel uncomfortable with such materials.

9. Underlying Layer

The underlying layer should be made of air permeable materials to allow diffusion of water molecules in the gaseous state. This would keep away the moist air to effectively reduce the moisture and heat between the sanitary napkins and the body so that there is a dry and refreshed feeling.

2.3 PROBLEMS FACED IN SANITARY NAPKIN USAGE:

The human body is a delicate and complex system. The menstrual cycle is a special characteristic of female maturity that brings both blessings and possible problems for women. The menstrual cycle will go on for about half the life of a woman, i.e. at least 2,000 to 3,000 days. During menstruations, the skin of the women's sensitive part is most vulnerable. Surveys have shown that 73% of the women would feel itchiness and pain on some parts of the skin during menstruation. These are mostly caused by the use of sanitary napkins which are not air permeable.

2.3.1Rash:

Napkin rash is a term which describes any irritation in the nappy area that causes the skin to become red and sore.

2.3.2. Symptoms of rashes:

Symptoms of infection during menstruation include mild fever, external genital infection, skin itch, ascending infections (such as vaginitis, cervicitis, pelvic inflammatory disease, endometritis etc), leukorrhagia, localized burning sensation or lower abdominal pain, or with fever, nausea; infections of urinary system including urinary tract infection, bladder infection, pyelonephritis, frequent micturition, urgent micturition, dysuria, waist sore and waist pain with fatigue or fever.

2.3.3. Causes of rashes due to Sanitary Napkins:

Rashes caused by sanitary napkins are common and can be quite uncomfortable. These rashes are also known as irritant contact dermatitis. Because sanitary pads consist of foreign chemicals like dioxin, they can sometimes cause painful irritations. Dioxins are byproducts of the pad- and tampon-manufacturing process. Most sanitary napkins are made of cotton and rayon. The process of producing rayon involves bleaching wood pulp, which produces dioxin. Fortunately, there are alternatives to wearing these types of sanitary napkins as well as cures for the rashes they may cause.

The other side effects of sanitary napkins is that if worn for more than three hours it can cause lumps on the vaginal area which might lead to irritation and other infections. The tampons which are another sanitary napkin contain two types of chemicals like that of Dioxin and Rayon which are equally dangerous for a woman. The Tampons are bleached with these chemicals to make them look pure and clean but the most harmful side effect of sanitary napkins / tampons is that this bleaching agent is toxic to the immune and reproductive system. There could be a more serious problem, like toxic shock syndrome (TSS). TSS is caused by two bacteria: staphyloccocus aureas and group a streptococcus.

2.3.4. Pesticides, Herbicides And Defoliants

- These are the chemicals that are used to spray on the cotton crops. A chemical named FURAN stays on the cotton long after it has been harvested, which is a potential danger which might cause harm. These have been linked with the following effects in the body:
- Birth defects of offspring
- Low birth weight
- Infertility
- Hormonal disruption
- Thyroid malfunction
- Diabetes
- Endometriosis
- Depression

2.3.5. Fragrances and Deodorants

These substances are added to the sanitary product during processing. Although they can also enter the bloodstream in a similar way to the pesticides and dioxin, they can also have an effect locally in the vagina and cause allergies and skin reactions.

2.3.6. Toxic Shock Syndrome

Toxic shock syndrome is not caused by the chemicals discussed above, but rather from an overgrowth of staphylococcus aureus bacteria in the vagina which causes a release of toxins and poisonous substances into the bloodstream. These toxins can cause a sudden fall in blood pressure and death. The presence of the tampon in the vagina for prolonged periods of time can encourage the growth of the staphylococcus bacteria, as can the use of synthetic fibers in tampons. The occurrence of these symptoms in conjunction with tampon use may be a sign of toxic shock syndrome:

- Sunburn-like rash
- Dizziness
- Confusion
- Cold and clammy skin
- Fever
- Sanitary pads are subject to the same considerations above in terms of the chemicals in the cotton used, the bleaching process, and the use of fragrances. Although they are in less contact with the internal vaginal wall they are still in contact with the external mucous membrane and chemicals on them can enter the bloodstream this way. Pads are also often made with a dry-weave plastic cover which can cause irritation and localized allergic reactions.

2.3.7. CAUSES OF RASHES BY MICROORGANISM

2.3.7.1 Microorganism:

Microbes are the tiniest creatures not seen by the naked eye. They include a variety of microorganisms like Bacteria, Fungi, Algae and viruses. Bacteria are uni-cellular organisms, which grow very rapidly under warmth and moisture.

2.3.7.2 Types of Bacteria:

1. Staphylococcus aureus

Gram positive (**Staphylococcus aureus) S. aureus** is a facultative anaerobic, Gram-positive coccus, which appears as grape-like clusters when viewed through a microscope, and has large, round, golden-yellow colonies, often with hemolysis, when grown on plates. **Staphylococcus aureus** is the most common cause of staph infections. "S. aureus" can cause a range of illnesses from minor skin infections, such as pimples, impetigo, boils (furuncles), cellulitis folliculitis, carbuncles, scalded skin syndrome and abscesses, to life-threatening diseases such as pneumonia, meningitis, osteomyelitis, endocarditis, toxic shock syndrome (TSS), bacteremia and septicemia.

2. Escherichia Coli

Escherichia coli commonly abbreviated E. coli is a Gram-negative, rod-shaped bacterium that is commonly found in the lower intestine of warm-blooded organisms (endotherMs). E. coli is Gram-negative, facultative anaerobic and non-sporulating. Cells are typically rod-shaped, and are about 2.0 microns (μm) long and 0.5 μm in diameter, with a cell volume of 0.6 – 0.7 (μm). It can live on a wide variety of substrates.

3. Pseudomonas Aeruginosa

It is a Gram-negative, aerobic, rod-shaped bacterium with unipolar motility.An opportunistic human pathogen, P. aeruginosa is also an opportunistic pathogen of plants.P. Aeruginosa is the type species of the genus Pseudomonas (Migula). P. aeruginosa is often preliminarily identified by its pearlescent appearance and grape-like or tortilla-like odor in vitro.Pseudomonas aeruginosa is an opportunistic bacteria that lives in soil, water, and even in environments like hot tubs. For most healthy people, this bacteria seldom poses a problem. Occasionally people will develop conditions like hot tub rash, and swimmer's ear, which may be due to contact with these germs.

2.3.7.3. Types of Fungi

Candida albicans

Vaginal yeast infection is an infection of the vagina, most commonly due to the fungus Candida albicans. Most women will have a vaginal yeast infection at some time. Candida albicans is a common type of fungus. It is often present in small amounts in the vagina, mouth, digestive tract, and on the skin. Candida and the many other germs or microorganisms that normally live in the vagina keep each other in balance. However, when the vagina has certain favorable conditions, the number of Candida albicans increases, leading to a yeast infection.

2.4. REMEDIES FOR INFECTIONS CAUSED BY SANITARY NAPKINS

Both Herbal & chemical remedies are very common in the treatment of different types of rashes.

2.4.1 Herbal remedies:

A variety of different herbals can be applied to different kinds of rashes. They are:

- agrimony (Agrimonia eupatoria) tea spray: hives and moist rashes
- aloe (Aloe vera) gel: weeping rash, shingles, burns, sunburn
- amaranth (Amaranthus hypochondriacus) tea wash: hives
- beech (Fagus grandifolia) tea wash: diaper rash and poison ivy or oak rash
- black walnut (Juglans nigra) leaf tea: rashes, rashes caused by parasites, scabies
- burdock (Articum lappa) decoction: hives, eczema
- calendula (Calendula officinalis) infusion: hives, burns, sunburn; calendula lotion: plant-contact dermatitis
- marigold flower
- cattail (Typha latifolia) paste: poison ivy rash
- chamomile tea wash: poison ivy, oak, or sumac rash
- comfrey (Symphytum officinale) ointment, cream, or lotion: inflamed rash; cold tea compress from comfrey root: plant-contact dermatitis
- oak bark (Querus alba) tea: rashes
- oatmeal bath: plant-contact dermatitis
- Basil (Tulsi) Leaves Paste - cure rashes
- Basil (Tulsi) is highly medicinal in nature and would treat your menstrual rash very quickly
- Neem (Azadirachta indica) Leaves Paste - treats skin infection in your butt region caused during periods.

2.4.2 Some Homeopathic Remedies Include:

- calcium sulfide (Hepar sulphuris) for rash with pus
- graphite (Graphites) for dry, red, cracked, itchy rash in the skin folds
- honeybee (Apies) for swelling and hives from bee stings
- nosode (Medorrhinum) for sharply defined red, possibly shiny, rash suggesting yeast infection
- stinging nettle (Urtica urens) for stinging hives with little inflammation
- Sulfur for dry, red, cracked, itchy rash anywhere, including around the anus.

2.4.3 Other Rash Remedies Include:

- **Aromatherapy:** The essential oils thyme, lavender, jasmine, and German chamomile may relieve allergy-induced eczema.
- **Ayurveda:** Rashes and hives are treated by drinking fresh cilantro juice and applying the pulp onto the rash. Fresh coconut water, melon rind, or a paste of turmeric (one part) and sandalwood (two parts) in goat's milk can be applied to the affected area. Hot milk (1 cup) containing coriander (1 teaspoon), cumin (1/2 teaspoon), and raw sugar (1 teaspoon) can be ingested once or twice daily to heal rashes and hives and restore skin health.
- **Chinese medicine:** Hives are treated with herbal preparations, acupuncture, ear acupuncture, and cupping. Preparations applied to the skin to relieve the itching associated with hives include Jie Du Cha Ji (Resolve Toxin Smearing Liquid), Zhi Yang Po Fen (Relieve Itching Powder), and Zhi Yang Xi Ji (Relieve Itching Washing Preparation). Contact dermatitis and drug dermatitis are treated with herbal formulas comprised of herbs chosen specifically for the patient's symptoms.
- **Diet:** An increased intake of mackerel, salmon, and herring provides essential fatty acids that may decrease itching and inflammation.
- **Hydrotherapy:** Hives can be relieved by rubbing the affected area with an ice cube, taking a cool bath, or using a cold compress.

- **Hypnosis:** Emotional stress can trigger many different dermatomes including certain rashes. Hypnosis has been helpful in treating atopic dermatitis, herpes, itching, psoriasis, hives, and other dermatomes.
- **Juice therapy:** Red rashes are treated with fresh apple, dark grape, papaya, or pineapple juices drunk at room temperature between meals.
- **Supplements:** Rashes may be treated with skin-repairing vitamins A, C, B complex, and zinc. Vitamin E can reduce skin dryness (decreasing the itch).

2.5. CURE FOR INFECTIONS CAUSED BY SANITARY NAPKINS:

There are various curative herbal & chemical remedial products which is available in market for to cure the rashes caused by sanitary napkins.

2.5.1. Commercially Available Herbal Products

1. Himalaya herbal rash cream:

A specially formulated mild cream that treats rashes, inflammation and irritation caused due to sanitary napkins.

Ingredients Include:

- Zinc calx (Yashad bhasma)
- Barbados Aloe (Aloe Vera)
- Almond (Prunus amygdalus)
- Five-Leaved Chaste Tree (Vitex negundo)
- Indian Madder (Rubia cordifolia)

2. Calendula Cream:

Calendula Cream is one of the most effective products for skin care. Calendula is a perennial plant that belongs to the Daisy family, Asteraceae.

Calendula Cream is made of the flowers of Calendula which is known to be an effective treatment for circulatory problems, eye infections, menstrual pains and menopausal disorders. Because of Calendula's proven ability to treat different kinds of skin problems, the Calendula cream has become popular in hospitals, clinics and households.

2.5.2 Commercially Available Chemical Products:

1. Fucidin Ointment:

Sodium fusidate is an antibiotic used to treat penicillin-resistant infections caused by Staphylococcus, including osteomyelitis. Fucidin Ointment applied on the skin will not generally interfere with other antibacterial treatment, for example antibiotic tablets or Injections. Fucidin Ointment is for use on the skin. It is not to be swallowed. Do not use this medicine if you have an allergy or have had an adverse reaction.

2. Clotrimazole Cream I.P.

Clotrimazole cream is a kind of medicine which contains the active ingredient clotrimazole. It is an antifungal medicine used for treating infections with fungi and yeasts. The substance clotrimazole kills fungi and yeasts by interfering with their cell membranes. We provide it in 15 Gms antifungal tube and pack it safely. Following is the composition of this cream:

Clotrimazole I.P.	10 mg.
Chlorocresol I.P. (As preservative)	1 mg.
Water Miscible Base	Q.S

3. Kremdid cream

Kremdid cream is extremely beneficial in terms of its treatment of fungal skin infections. This antifungal medicine is available in a tube of 15 Gms and is packed keeping all the safe precautions. Following is the composition of cream:

Clotrimazole I.P.	1% w/w
Chlorocresol I.P.(As preservative)	0.1% w/w
Water Miscible Base	Q.S.

4. Miconazole nitrate cream

This miconazole nitrate cream is used for the purpose of treatment of antifungal and associated bacterial infections of the skin. Our cream is packed in 15 Gms tube and is prevented from all the impurities. Following is the composition of cream:

Miconazole Nitrate I.P.	2% w/w
Chlorocresol I.P. (As preservative)	0.1% w/w
Cream Base	Q.S.

2.6. PREVENTIVE MEASURES FOR INFECTIONS CAUSED BY SANITARY NAPKINS

For ordinary sanitary napkin used continuously for two hours, its surface may have bacteria numbering up to 107 per square centimeter and this contamination may seriously affect the health of the women. The bloodstained pads sometimes rub against the skin of the thigh, which gets sore and causes discomfort while walking. Hence, the thigh region should be kept dry

- Changing your pads often helps keep bacteria from accumulating. Also, wearing synthetic-lined pads can irritate your skin, so try pads made from unbleached cotton.
- Apply creams to the infected area. Topical steroids like 1-percent hydrocortisone are recommended.
- Cleaning the area with warm water and unscented soaps, and using unscented moisturizing lotions are simple remedies.
- Availability and Accessibility of sanitary napkins at subsidized price in schools, Anganwadi centers and health centres.
- Awareness campaigns focusing adolescent girls on use of cloth as a napkin, washing, drying, storing, disposal etc as done in the School Education Program.
- Providing Information to girls and to their mothers and community at large on female anatomy, menstruation cycle, how to maintain reproductive health.
- Nowadays A specially formulated herbal cream that treats rashes, inflammation and irritation caused due to sanitary napkins.

- Apply a Paste of herbal to the irritated area near your vagina or butt cure the rashes herbal is anti-bacterial in nature and treats the infection in your butt region caused during periods.
- Herbal is an eco-friendly & doesn't cause any side effects.

2.7 HERBS:

Herbs are any plants with leaves, seeds, or flowers used for flavoring, food, medicine, or perfume" or parts of "such a plant as used in cooking". Herbs have a variety of uses including culinary, medicinal, and in some cases spiritual usage. General usage differs between culinary herbs and medicinal herbs.

In medicinal or spiritual use any of the parts of the plant might be considered "herbs", including leaves, roots, flowers, seeds, resin, root bark, inner bark (and cambium), berries and sometimes the pericarp or other portions of the plant. Culinary use of the term "herb" typically distinguishes between herbs, from the leafy green parts of a plant (either fresh or dried), and spices, from other parts of the plant (usually dried), including seeds, berries, bark, root and fruit.

2.8. TYPES AND PROPERTIES OF VARIOUS HERBS:

There are different varieties of herbs used for. The herbal properties & its functions are given in table below.

TABLE -2 PROPERTIES OF VARIOUS HERBS:

S.No	Herbal Name	Functions	Properties
1.	Aloe vera	Aloe vera products contain the highest concentrations of healing agent which is beneficial for the skin	Healing agent
2.	Turmeric	Although it is primarily known for its anti-allergic properties, it may also help heal rashes.	Anti-allergic properties
3.	Marigold (Calendula officinalis)	It is an excellent anti-inflammatory and prevents infection with its anti-bacterial, anti-viral and anti-fungal properties.	Anti-bacterial, anti-viral and anti-fungal properties.
4.	Tea Tree Oil Common Names Tea , Green Tea, Black tea	It is used widely for various skin conditions due to its anti-bacterial, anti-fungal, and healing properties. Good for soothing all skin irritations.	Anti-bacterial, anti-fungal, and healing properties.
5.	Poovarasu tree leaves	It is an excellent anti-inflammatory and prevents infection with its anti-bacterial, anti-viral and anti-fungal properties.	Anti-bacterial, anti-fungal, and healing properties
6.	Neem	It is an excellent anti-inflammatory and prevents infection with its anti-bacterial, anti-viral and anti-fungal properties.	Anti-fungal properties
7.	Lavender Essential Oil	It is valued for its antiseptic, healing and calming properties and is wonderful for reducing discomfort and improving natural healing of rash.	Antiseptic, healing and calming properties.

2.9. METHODS OF EXTRACTION :

Infusion: The simplest extraction method; it's similar to making a tea, but more precisely defined. Infusions are most appropriate when extracting constituents from leaves, flowers and green stems. General guidelines suggest one part dried herb or three ounces fresh herb to twenty parts water steeped five to ten minutes.

Decoction: Similar to an infusion but used when the plant material is hard and woody, such as roots, rhizomes, seeds, or bark. Simmer one part herb to twenty parts water for fifteen to twenty minutes.

Maceration: The most common or popular way to tincture an herb, this process usually calls for ethanol, or grain alcohol, which is a better solvent than water because it extracts most of the ingredients from the herb and also acts as a preservative. Occasionally vegetable glycerine or vinegar is used—vinegar behaves similarly to alcohol, and glycerine is easier on the stomach—but neither of them dissolves plant constituents as well as alcohol. Vinegar and glycerine are appropriate for children or people with alcohol sensitivities. Herbs are placed into a container and alcohol is added; a common ratio is one part herb to five parts solvent.

Digestion: Similar to maceration, but with the addition of gentle heat.

Expression: Forcibly separating liquid from the plant by using a press.

Percolation: One method for extracting dried, finely powdered herbs. The powder is placed into a vial, a paper filter is set on top, and solvent is poured onto the filter. The solvent works its way through the powder for twenty-four hours (more solvent is added as needed) and drips slowly out of a valve on the bottom of the vial—carrying the extracted medicinal constituents with it.

2.10. METHOD OF APPLICATION ON TEXTILE MATERIAL:

The herbal extracted solution can be applied to the textile substrates by exhaust, pad-dry-cure, and Microencapsulation techniques. Types of method used:

2.10.1. Padding Method:

- The extracts of herbs were directly applied on the fabric by pad-dry-cure method.
- Herbal extract was applied on fabric with extracted solution using high pressure pneumatic padding mangle.
- During padding the fabric was immersed in a extracted solution and it is passed through inbetween the padding rolls. The roller squeezes the excess solution from the fabric.
- Padding was carried out in a pneumatic padding mangle at room temperature and a pressure of 3 psi to be maintained to get a pickup of 70% dry on wet of fabric. During the process the PH level of 7 to be maintained.

Drying and Curing

Drying and Curing were carried out in drying chamber at 100 degree Celsius for 5 minutes.

2.10.2 Exhaustion Method:

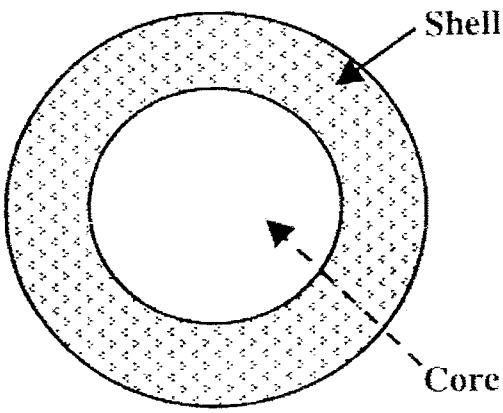
The exhaustion method was carried out with cross linking agent. Five grams of fabric was finished at a liquor ratio of 20:1. The temperature of the bath was raised to 100□C at the rate of 2□C/min and maintained at this temperature for 30 min. Then glyoxal as a crosslinking agent was added in the bath and left to stand for another 30 min. After that, the temperature of bath was reduced to 60□C. The herbal treated fabric was rinsed with tap water, and soaped. Finally, the treated fabric was washed with tap water, squeezed and re-dried in the oven.

2.10.3. Spray Technique:

In this method, the herbal or chemical solution is sprayed on the surface of fabric by means of spray gun. This method is only suitable when the fabric has more absorbency property.

2.10.4. Microencapsulation technology

Microencapsulation technology allows a compound to be encapsulated inside a tiny sphere known as mi crosphere/microcapsule, having an average diameter as small as 1 mm toseveral hundred micro meters. Many different active materials like drugs, enzymes, vitamins, pesticides, flavours and catalysts have been successfully encapsulated inside microballoons or microcapsules made from a variety of polymeric and non polymeric materials including poly(ethylene glycol)s, poly(methacrylate)s, poly(styrene)s, cellulose, poly(lactide)s, poly(lactide-co-glycolide)s, gelatin and acacia, etc. These microcapsules release their contents at appropriatetime by using different release mechanisms, depending on the end use of encapsulated products.



- The releasing of the content from the capsules is one of the interesting aspects of the wall materials.
- It is dependent directly on the type of wall material used, the no of layer present around the core and the concentration of the wall material.
- However there are three basic mechanisms through which capsule release the content to outside. These are

  - Diffusion
  - Enzymatic digestion
  - Surface leaching through chemicals

METHODOLOGY

3. METHODOLOGY

3.1 Objectives:

- To identify the best herbal anti-rash finish on the spun bonded polypropylene sheet used as the outer cover stock for the sanitary napkins.
- To select the best method of application of the selected herbal anti-rash finish on the spun bonded polypropylene sheet used as the outer cover stock for the sanitary napkins.

3.1.2. Process Flow Chart:

IDENTIFYING HERBS WITH ANTI RASH ACTIVITY

↓

SELECTION AND PROCUREMENT OF HERBAL LEAVES

↓

EXTRACTION OF THE SOLUTION FROM SELECTED HERBAL LEAVES

↓

APPLICATION OF ANTI RASH FINISH ON OUTER COVER STOCK

↓

TESTING THE ANTI MICROBIAL ACTIVITY OF THE APPLIED ANTI RASH FINISH ON THE OUTER COVER STOCK

↓

PREPARATION OF ABSORBENT CORE

↓

PREPARATION OF THE COVERSTOCK

↓

ASSEMBLING THE SANITARY NAPKIN

↓

PERFORMANCE TESTING OF SANITARY NAPKIN

3.2 IDENTIFYING HERBS WITH ANTI RASH ACTIVITY:

Herbs are any plants with leaves, seeds, or flowers used for medicinal purpose. In medicinal or spiritual use any of the parts of the plant might be considered "herbs", including leaves, roots, flowers, seeds, resin, root bark, inner bark (and cambium), berries and sometimes the pericarp or other portions of the plant. There are various herbals used to cure the rashes caused by sanitary napkins. Herbs are generally fresh or dried leaves of low growing plants.

Herbal leaves have been mostly used rather than other parts of herbs because of its properties and also used in both fresh & dry condition. Herbal leaves basically have anti-microbial, anti- allergic properties which can cure the rashes. The various herbal leaves which have anti-microbial activities were identified. The herbal leaves have anti-microbial properties are:

- Turmeric leaves(curcuma longa)
- Neem leaf (Azadirachta indica)
- Aloe vera leaves(Barbados Aloe)
- Poovarasu tree leaves (Thespesia populnea)
- Tee tree leaves

3.3. PROCUREMENT & EXTRACTION OF THE SOLUTION FROM HERBAL LEAVES:

The herbal leaves of **Turmeric** leaves (curcuma longa), Aloe vera leaves (Barbados Aloe) Poovarasu tree leaves (Thespesia populnea), neem leaf (Azadirachta indica), tee tree oil were procured from local area.

The juice was extracted from the herbal leaves by means of crushing the leaves in wet condition. After extracting the solution from herbs it is filtered using fine filter paper. Then the prepared solution was sterilized in order to control the microbial growth. After sterilized it is tested for its anti-microbial activity.

3.4. TESTING OF EXTRACTED SOLUTION FOR ANTI MICROBIAL ACTIVITY

3.4.1 Anti Bacterial Tests: AATCC -147-1988 (Qualitative Method)

PROCEDURE:

2.8 grams of nutrient agar is mixed with 100 ml of water in a conical flask and shake well for diluted into solution. The cotton is plugged into the head of the conical flask. The nutrient agar & Petri plates should be autoclaved at a temp of 121 deg c for 15 min. The laminator airflow chamber is cleaned well with ethanol & sterilized. The tips used for pipette out of bacteria should be sterilized.

The agar was then poured on to the Petri plates & it is allowed to solidify. The Petri plates are kept on town table & 25 µl of bacteria is pipette out and poured in the solidified agar. Using L- rod the bacteria is spread evenly using turn table. The well is cut in the agar. Then the extracted solution is pipette out in the concentration of 50 µl & 100 µl & 150 µl also the anti- biotic disc is placed on the agar to check its inhibition. Then it is kept in incubator at 38 deg c for 12 hours. After 12 hours the zone is clearly seen in plates and it's measured in millimeter or centimeter. Higher the zone of inhibition gives better anti-bacterial activity. In this way the various extracted solutions namely Thespesia populnea (Poovarasu Tree Leaves), Curcuma longa (Turmeric Leaves) and Barbados Aloe (Aloe Vera leaf), Aloe vera gel (Barbados Aloe) and Neem oil (Azadirachta indica) were tested for various bacteria's namely gram- positive Staphylococcus Aureus, gram-negative Escherichia Coli and gram-negative Pseudomonas Aeruginosa for its anti- bacterial activity. The Qualitative Antibacterial activity was tested for the following microbes:

1. Staphylococcus Aurous

S. aureus is a facultative anaerobic, Gram-positive coccus, which appears as grape-like clusters when viewed through a microscope, and has large, round, golden-yellow colonies, often with hemolysis, when grown on blood agar plates. "S. aureus" can cause a range of illnesses from minor skin infections, toxic shock syndrome (TSS), bacteremia and septicemia.

2. Escherichia Coli

Escherichia coli commonly abbreviated E. coli is a Gram-negative, rod-shaped bacterium that is commonly found in the lower intestine of warm-blooded organisms (endosperms).

3. Pseudomonas Aeruginosa

It is a Gram-negative, aerobic, rod-shaped bacterium with motility. An opportunistic human pathogen, P. aeruginosa is also an opportunistic pathogen of plants'. Aeruginosa is the type species of the genus Pseudomonas (Migula). . Occasionally people will develop conditions like hot tub rash, and swimmer's ear, which may be due to contact with these germs.

3.4.2 Anti – Fungi Test: AATCC 30 (Qualitative Method)

PROCEDURE:

3.4 grams of nutrient agar is mixed with 100 ml of water in a conical flask and shake well for diluted into solution. The cotton is plugged into the head of the conical flask. The nutrient agar & Petri plates should be autoclaved at a temp of 121 deg c for 15 min. The laminator airflow chamber is cleaned well with ethanol & sterilized. The tips used for pipette out of bacteria should be sterilized. The agar was then poured on to the Petri plates & it is allowed to solidify. The Petri plates are kept on town table & 25 µl of fungi is pipette out and poured in the solidified agar. Using L- rod the bacteria is spread evenly using turn table.

The well is cut in the agar. Then the extracted solution is pipette out in the concentration of 50 µl & 100 µl & 150 µl also the anti- biotic disc is placed on the agar to check its inhibition. Then it is kept in incubator at 38 deg c for 12 hours. After 12 hours the zone is clearly seen in plates and it's measured in millimeter or centimeter. Higher the zone of inhibition gives better anti-bacterial activity. In this way the various extracted solutions namely Thespesia populnea (Poovarasu Tree Leaves), Curcuma longa (Turmeric Leaves) and Barbados Aloe (Aloe Vera leaf) were tested for its anti-fungi activity against Candida albicans.

After testing of various solutions for its anti-microbial activity, we have found extracted solutions namely Thespesia populnea (Poovarasu Tree Leaves), Curcuma longa (Turmeric

Leaves) and Barbados Aloe (Aloe Vera leaf) herbs extract solution which has better anti-microbial activity than other herbs extract solution. From the test results we have selected three herbs which have better anti-microbial activity. The Qualitative Antifungi activity was tested for the following microbe:

1. Candida Albicans:

Vaginal yeast infection is an infection of the vagina, most commonly due to the fungus Candida albicans. Most women will have a vaginal yeast infection at some time. Candida albicans is a common type of fungus. It is often present in small amounts in the vagina, mouth, digestive tract, and on the skin. Candida and the many other germs or microorganisms that normally live in the vagina keep each other in balance. However, when the vagina has certain favorable conditions, the number of Candida albicans increases, leading to a yeast infection.

3.5. PROCUREMENT OF RAW MATERIALS FOR SANITARY NAPKIN ASSEMBLY:

Materials used in absorbent hygiene products:

- Permeable Top cover- Polypropylene
- Leak proof Impermeable Bottom cover- Polyethylene
- Absorbent core – bamboo fibre
- Super absorbent gel

The above raw materials required for assembling the sanitary napkin was purchased from Ganthigram Trust, Dindigul.

3.6. EXTRACTION OF HERBAL SOLUTION FROM THE SELECTED HERBAL LEAVES

Thespesia populnea (Poovarasu Tree Leaves), Curcuma longa (Turmeric Leaves) and Barbados Aloe (Aloe Vera leaf) herbal leaves were selected among from varieties of herbs because of its better anti-microbial activity than other herbs. The juice was extracted from the fresh leaves of selected herbs by means of crushing the leaves. After extracting the solution from

herbs it is filtered using fine filter paper. Then the prepared solution was sterilized in order to control the microbial growth.

3.7 APPLICATION OF FINISHES ON OUTER COVER STOCK:

Following table lists the varieties of cover stock sample prepared based on combination of finishes applied on it.

TABLE -3 VARIETIES OF COVER STOCK SAMPLE

Sample No.	Cover stock Composition	Abbreviation Of cover stock sample
1	Untreated Polypropylene	U -PP
2	Untreated Polypropylene	C&S -PP
3	Turmeric herbal treated Polypropylene	HT - PP
4	Aloe Vera herbal & cool and soft finish treated Polypropylene	HA-PP
5	Poovarsu herbal Finished Polypropylene	HP-PP
6	Mixed solution herbal Finished Polypropylene	HM-PP
7	Turmeric herbal+ cool and soft finished Polypropylene	HT-C&S -PP
8	Aloe Vera herbal+ cool and soft finished Polypropylene	HA-C&S-PP
9	Poovarsu herbal +Cool and Soft Finished Polypropylene	HP-C&S-PP
10	Mixed solution herbal +Cool and Soft Finished Polypropylene	HM-C&S-PP

3.7.1 Pad –Dry – Cure Method:

It is a method of applying finish to a textile substrate by means of pad- dry cure method. A suitable technique of pad-dry cure method was selected for applying herbal extract solution and cool& soft chemicals on the polypropylene nonwoven sheet.

3.7.2 Application of finish:

- The extracts of herbs were directly applied on the 100% polypropylene nonwoven sheet by pad-dry-cure method.
- 30 Gpl of herbal extract was applied on polypropylene sheet along with 5 Gpl of wetting agent (hostabal MRN). The final solution of 1000ml was prepared for finish the nonwoven sheet.
- Padding was carried out in a pneumatic padding mangle at room temperature and a pressure of 3 psi to be maintained to get a pickup of 70% dry on wet of fabric. During the process the PH level of 7 to be maintained.

DRYING AND CURING

Drying and Curing were carried out in drying chamber at 100 degree Celsius for 5 minutes.

3.7.3 Application of cool and soft finish:

During the menstruation cycle the temperature of body will increased which leads to growth of microbes .so it will affect the comfort of body..to control this problem the the cool finish is applied on the outer cover stock of sanitary napkin to maintain the body temperature and control the growth of microbes. the cover stock which is close contact with the vulnerable part of human skin will lead to irritate the skin. So the soft finish applied for improve the smoothness of outer cover stock

Cool finish: The body temperature is balanced due to the moisture management function of this finish. The sweat from the body is immediately absorbed by the fabric and due to this finishing; the sweat will be evaporated within seconds. So the body will feel comfort. It imparts excellent softness and makes the fabric more breathable.

Soft finish: Softening finishes are among the most important of textile chemical after treatments. With chemical softeners, textiles can achieve an agreeable, soft hand (supple, pliant, sleek and

fluffy), some smoothness, more flexibility and better drape and pliability. The perceived softness of a textile is the combination of several measurable physical phenomena such as elasticity, compressibility and smoothness. Other properties improved by softeners include the feeling of added fullness, antistatic properties.

The cool & soft finish recipe:

- Hydro perm HV - 5gpl
- Solusoft RPU - 30gpl
- Ceraperm - 30gpl

The above prepared cool& soft solution were directly applied on the 100% polypropylene herbal finish nonwoven sheet by pad-dry-cure method. Padding was carried out in a pneumatic padding mangle at room temperature and a pressure of 3 psi to be maintained to get a pickup of 70% dry on wet of fabric. During the process the PH level of 7 to be maintained. The Hydro perm HV acts as a coolant, Solusoft RPU as a fixing agent and Ceraperm is as a softening agent.

DRYING AND CURING:

Drying and curing were carried out in drying chamber at 100 deg c for 5 minutes.

3.7.4. Application of Herbal leaves extract along with cool and soft finish

After finishing the herbal extract solution on the polypropylene sheet the cool & soft finish was applied on it. The cool & soft finish recipe:

- Hydro perm HV - 5gpl
- Solusoft RPU - 30gpl
- Ceraperm - 30gpl

The above prepared cool& soft solution were directly applied on the 100% polypropylene herbal finish nonwoven sheet by pad-dry-cure method. Padding was carried out in a pneumatic

padding mangle at room temperature and a pressure of 3 psi to be maintained to get a pickup of 70% dry on wet of fabric. During the process the PH level of 7 to be maintained.

DRYING AND CURING

Drying and curing were carried out in drying chamber at 100 deg c for 5 minutes.

3.8 .TESTING THE COMFORT AND DIMENSIONAL PROPERTIES OF FINISHED AND UNFINISHED COVER STOCK

3. 8.1 Comfort Properties of Cover Stock:

- 3.8.1.1 Anti microbial test
- 3.8.1.2 Thermal conductivity test
- 3.8.1.3 Water Vapour Permeability test
- 3.8.1.4 Air permeability test
- 3.8.1.5 Wickability test

3.8.1.1 QUALITATIVE ANTI-MICROBIAL TEST:

As referred in 3.4 the anti- microbial test for finished cover stock was carried out.

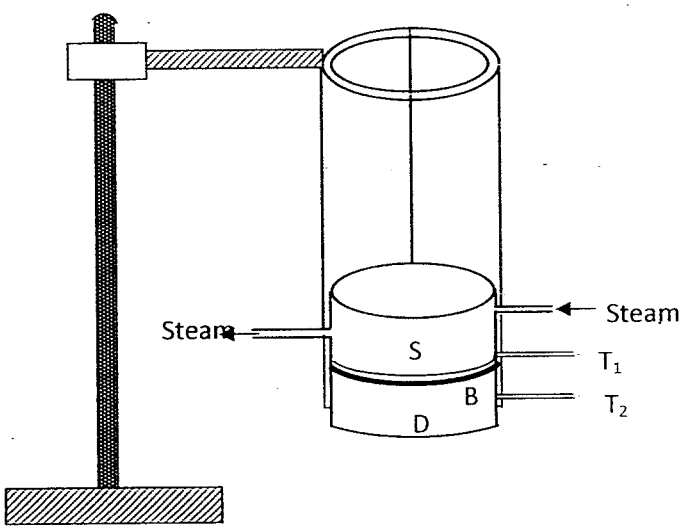
3.8.1.2 THERMAL CONDUCTIVITY TEST (ASTM D 135)

The quantity of heat conducted per second normally across unit area of cross section of the material per unit temperature difference. It denotes the heat conducting power. Its unit is Watts/metre/Kelvin.

The Lees disc set up is arranged as shown in fig. Steam is passed through the chamber. As heat gets conducted into the brass disc through the bad conductor, it gets heated up. The temperature is noted from time to time. At one stage the temperature becomes steady. When the temperature becomes steady for atleast 10 minutes the steady temperature is noted ($\theta_2{}^0$C). The temperature of steam is noted ($\theta_1{}^0$C). Now the cardboard is removed and the brass disc is heated in direct contact

with the steam chamber until the temperature rises by about 5^0C above the steady temperature. The disc is now separately suspended from the ring after removing from the steam chamber. Temperatures are noted in steps of 30secs from $(\theta_2 + 5)\ ^0$C to $(\theta_2 - 5)\ ^0$C and the values are tabulated (Table). A graph is drawn with temperature on the Y axis and the time on the X axis.

A horizontal line is drawn corresponding to steady temperature $\theta_2\ ^0$C. The time dt for a fall of temperature of $\theta_2\ ^0$C is found by taking two points one degree above 2 and the other one degree below (Fig). Note down the mass (M) of the brass disc B as noted over it or determine its mass using balance. Its diameter is found and hence the radius (r) is determined using vernier calipers. The thickness (l) of the brass disc is found using vernier calipers and thickness of the bad conductor (d) with a screw gauge.



Lee's Disc Apparatus

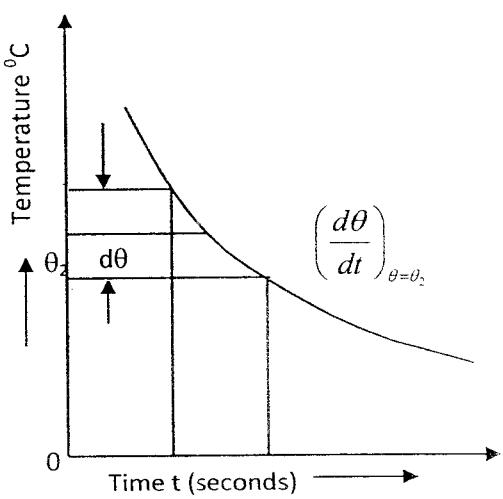


TABLE -4: TO FIND TIME TEMPERATURE READING FOR COOL & SOFT FINISHED SAMPLE

Temperature ^{0} C	Time in secs
87	0
86	23
85	47
84	73
83	100
82	127
81	154
80	185
79	211
78	247
77	270

FORMULA:

The coefficient of thermal conductivity of a bad conductor

$$K = \frac{Msd\,(r + 2l)\ \ (d\theta/dt)}{\pi r^2\,(2r + 2l)\,(\theta_1 - \theta_2)}\ \text{Watt/Metre/Kelvin}$$

Where

M - Mass of the disc placed over the experimental disc X 10^{-3} (Kilogram)

S -Specific heat of the material of the disc (Joule/Kilogram/Kelvin)

d - Thickness of the bad conductor (polypropylene sample) in (metres)

r - Radius of the brass disc in (metres)

l - Thickness of the brass disc in (metres)

θ_1 - temperature of the steam in (Degree Celsius)

θ_2 -Steady temperature in (Degree Celsius)

$d\theta/dt$ - rate of heat radiation of the brass disc at θ_2 (Kelvin/ second)

CALCULATIONS:

Formula Used: $K = \frac{Msd\,(r + 2l)\,(d\theta/dt)}{\pi r^2\,(2r + 2l)\,(\theta_1 - \theta_2)}$ Watt/ Meter/ Kelvin

Here, M = 0.825 Kilogram

s = 372 Joule/Kilogram/Kelvin

d = $.25 \times 10^{-3}$ metre

Circumference of the brass disc $2\pi r = 35 \times 10^{-2}$ metre.

r = 5.57×10^{-2} metre

l = 0.995×10^{-2} metre

θ_1 = 93° C

θ_2 = 82° C

$d\theta/dt$ = 0.0370 Degree Celsius /Second

$r + 2l = 7.56 \times 10^{-2}$ metre

$2r + 2l = 13.13 \times 10^{-2}$ metre

$$K = \frac{0.825^3 \times 372 \times 0.25 \times 10^{-3} \times 7.56 \times 10^{-2} \times 0.0370}{3.14 \times (5.57 \times 10^{-2})^2 \times 13.13 \times 10^{-2} \times (93^\circ - 82^\circ)}$$ (Watt/ Meter/ Kelvin)

K = 0.014380 (Watt/ Meter/ Kelvin)

The coefficient of thermal conductivity of a polypropylene cool& soft finished sample (k) =0.014380 (Watt/ Metre/k)

I n this way the coefficient of thermal conductivity of a polypropylene untreated and herbal +cool & soft finished samples were calculated. The results are given in table below.

3.8.1.3 WATER VAPOUR PERMEABILITY TEST (ASTM E9680)

The water vapor permeability is the time rate of water vapor transmission through unit area of flat material of unit thickness induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions. The water vapour permeability of the fabrics is in important property for those used in clothing systems intended to be worn during vigorous activity and hot climatic condition .The human body cool itself by sweat production and evaporation during period of high activity. The clothing must be able to remove this moisture in order to maintain comfort and reduce the degradation of the thermal insulation caused by moisture build-up.the rate of moisture vapor diffusion through the fabric is determined according to the simple dish method, similar to ASTM E96-80. A Sample is placed on a water dish 82mm19mm in depth allowing a 9mm air space between the water surface and specimen. A free vibration free turntable carrying 8 dishes rotates uniformly at 5m/min to ensure that all dishes are exposed to the same average ambient condition during th2 test. The assembled specimen dishes allowed stabilizing for 2hours.before taking the initial weight. They are weighed again after 24 hour interval. Then the rate of moisture vapor loss (MVTR)is calculated in units in g/m2-24 hours. A higher MVTR value indicates there is a greater passage.

TABLE – 5: WATER VAPOUR PERMEABILITY TEST

Before test	**After test**	**Time difference**	**water vapor permeability (in gm/m2/day)**	**time**
144.15	140.42	3.73	2363.31	7 hours

Formula:

Water vapor permeability = 24 M / A t gm/m2/day

Where,

M- Mass difference, A – area of the cup (0.0054113 m2), T – time in hours

3.8.1.4 AIR PERMEABILITY TEST: ASTM D6476

The rate of air flow of 1 cubic cm head of pressure passed perpendicularly through a known area of fabric of 1 cm^2 for 1 min.

3.8.1.4.1 Air Permeability Tester:

Air Permeability tester for textiles is used for testing air permeability of fabrics. This system consists of an arrangement for holding the test specimens between two flat faces so as to expose a known area to the flow of air through it, a vacuum system to draw air through the exposed area of the test specimens. There is an arrangement to measure the volume of air flowing through the test specimen, and arrangement to measure the pressure drop between the faces of the test specimen. The test specimen is hold between two round-shaped grips. The grips are lined with rubber gasket to avoid the leakage of air through the edges. The two grips can be held the test specimens with the help of a hand operated screw mechanism.

The vacuum needed to draw the air through the test specimens is created with the vacuum pump supplied with the instrument. The vacuum pressure is measured by the digital manometer (or manometer tube) in terms of mm of water level & airflow is measured by the Rota meters attached with the instrument. Read and record the individual test results in SI units as cm^3/s/cm^2 and in inch-pound units as rounded to three significant digits.

Test procedure :

This method of measure the air permeability of textile fabrics:

- Sample is conditioned in atmospheric conditions for textiles
- Sample is placed on the machine and air is drawn through the fabric
- Testing reported in cfm – Cubic Feet Per Minute

3.8.1.5 Fabric Wickability Test: ASTM D1777

The term of wickablity is important with performance s fabrics as it is the "ability of a fabric to disperse moisture, allowing it to pass through the surface of the fabric so that evaporation can take place". The quicker the moisture can be dispersed over the fabric and the more surface area the fabric has, the better its ability to allow the moisture to evaporate off of the fabric.

Test Procedure:

Simply cut the fabric into a 5" strip with a 1" width. Then mark centimeter unit along the lengthwise direction Tape the one end of the fabric to the middle of a pen (or pencil), so that the fabrics hang down 5". Fill a glass half full of dye solution(50g dye in 100mlof water)Dangle the fabric over the dye solution so that the end of the fabric just touches the top of the dye solution , then count the amount of seconds it takes to travel each centimeter upwards to the pen. Note the time (seconds 0r minute) for reaching every centimeter of fabric by dye solution.

If the dye solution reaches the pen in under a minute, it has excellent wicking ability. If the water does not travel up the strip, then the fabric has poor wicking. This simple test allows you to compare fabrics to determine which has a better ability to wick. Higher wicking value show greater liquid water transport.

3.8.2 DIMENSIONAL PROPERTIES OF FINISHED AND UNFINISHED COVER STOCK:

The various dimensional properties of finished and unfinished cover stock were tested. The physical properties tested are:

3.8.2.1. MEASUREMENT OF GSM

3.8.2.2 MEASUREMENT OF THICKNESS

3.8.2.3 TENSILE STRENGTH TEST

3.8.2.4 SPECTROPHOTOMETER COLOUR ANALYSIS

3.8.2.1 MEASUREMENT OF GSM: ASTM D3776

GSM cutters are used to determine accurately the GSM (Grams per square meter) of any type of fabrics. This GSM Cutter is circular fabric sample cutter with which uniform circular fabric is cut without measuring. The specimen which is cut with the help of fabric GSM cutter is 100 cm2 areas. After cutting its weighted in weighing balance. The fabric weight shows the grams / square centimeter of fabric.

3.8.2.2 MEASUREMENT OF THICKNESS: ASTM D 6859

The thickness of the nonwoven sheet was carried out with the help of a precision Thickness Gauge. In this equipment, the fabric whose thickness is to be determines kept on a flat anvil and circular pressure foot is pressed on to it from the top under a standard fixed load. The Dial Indicator directly gives the Thickness in mm.

3.8.2.3 TENSILE STRENGTH TEST: ASTM D 638

Instron Tensile Strength Tester:

The breaking strength is a measure of the resistance of the material to a tensile load.The tensile strength of non woven fabric is usually measured by instron universal tester with costant rate of loading.

Sample preparation:

The sample size for testing the tensile strength is following

Length=15cm

Width=2.5cm

Test procedure:

Fix the sample in between two jaws and top jaw is movable one. After the samples fixed the top jaw is moving at the principle of constant rate of loading. The instron universal tester shows the data in breaking load in gf/tex and elongation at break.

3.8.2.4 SPECTROPHOTOMETER COLOUR ANALYSIS (ASTM-E2371)

Spectrophotometer is working on the principle of electronic Instrumental color measurement systems. It is mainly used for color analysis testing of fiber, yarn,& fabric. Spectrophotometers available include Dual Beam Sphere for use in retailer color management programs, 45° Illumination and 0° viewing for fluorescent samples and Dual Beam Sphere with Near Infra Red capability for military programs. All of them are interfaced with state of the art color management and communication software. These instruments provide objective, quantitative visual color measurement and assessment as well as shade sorting, shade grouping and banding, tapering, lab dip approval as well as objective rating of colorfastness test results such as crocking, laundering, light, storage and perspiration.

TEST PROCEDURE:

Determine the absorption spectra of one of the standards distributed in lab (qualitative analysis). ASTM-E2371

a. **Warm-up Spec 20** – allow at least 20 min before taking readings.

b. **Prepare a blank cuvette** – place 3 ml of potassium acetate into a clean Spec20 tube. Use this cuvette to zero the instrument as described by your TA (directions are also available here).

c. **Zero the Spec 20** – Set the wavelength dial on the Spec 20 to 350 nm. With the sample chamber empty, turn the left hand knob on the front of the spectrophotometer until the needle reads 0% Transmittance (upper scale). Next, place your reference blank into the sample compartment making sure to line up the marks on the cuvette and the sample compartment of the Spec 20. Adjust the right hand knob until the needle reads 100% Transmittance (this process cancels out background absorbance).

d. **Measure the absorbance of your sample at 350 nm** – Once the Spec 20 is zeroed, remove the blank cuvette and place your sample cuvette into the sample compartment. Read and record the absorbance value (A) on the **lower absorbance scale** (not the Transmittance or upper scale that you used to zero the instrument). If A is greater than 0.6, dilute your sample by 10 fold (i.e., 1 volume of undiluted solution mixed with 9 volumes of diluent so that the final concentration is 1/10 of the original strength). Read and record A again. If the value is below 0.6, continue on to the next step. If not, you will need to do an additional dilution(s) before you can read and record the absorbance of the diluted sample. Keep a record of all dilutions as described below.

e. **Determine the absorbance of the diluted sample at 50 nm intervals between 350-700 nm** - this will give you a ballpark estimate of where the sample absorbs most (peaks) and least (valleys). If the absorbance of the sample is greater than 0.6 at any wavelength between 350-700 nm, dilute the solution until all of your absorbance readings fall below 0.6. If necessary, repeat all of your readings at the same dilution.

f. **Establish the λmax of your sample** - in regions where you are approaching absorption maxima (i.e., absorbance's increase to a peak), determine A at 10 nm rather than 50 nm intervals. The λ_{max} of the sample is the λ that yields the highest A value. Keep in mind that the Spec20 has a bandwidth of about 10 nm, so there is no advantage in measuring the absorbance at shorter wavelength intervals (e.g., 5 nm).

g. **Plot your data on graph paper** – plot absorbance (A) on the y-axis as a function of wavelength (λ) on the x-axis.

In this way the various treated polypropylene cover stock is compared with standard untreated polypropylene cover stock for its colour shade variation. Then the test results were plotted on a graph paper.

3.9 SELECTION AND PREPARATION OF FIBRES FOR ABSORBENT CORE

Bamboo fibre is selected for preparation of absorbent core of sanitary napkin for the following reasons:

- Moisture content and moisture regain of bamboo fibre 12.7 % and 14.5% respectively. It is almost double as that of organic cotton fibre.
- Absorbing or releasing moisture, breathable, wear comfortable, do not leave sweat, chill.
- Good natural antibacterial, antimicrobial function, significant UV protection, soft, smooth, with a special bamboo texture and drape, easy care. Therefore bamboo fibre products do not cause skin allergies.
- The moisture content% & moisture regain% of bamboo fibre is 12.7% and 14.5% respectively.

3.10 FORMATION OF WEB FOR ABSORBENT CORE

The bamboo fiber is used for preparing absorbent core of sanitary napkins. The 40 grams of fibres were weighted in a weighing machine. After weighing the fibers were processed on the mini carding machine. The fibers are well opened and converted into the form of web. These prepared webs are used directly for the absorbent core in the sanitary napkins

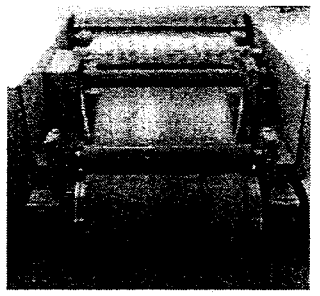


Figure:2 Mini carding m/c

3.11 PREPARATION OF OUTER COVER STOCK:

An per end result obtained from anti- microbial activity of cover stock of polypropylene which has better anti-microbial properties have been selected for preparation of sanitary napkin outer cover stock. From this the turmeric treated and turmeric + cool& soft polypropylene outer cover sheet was selected for making sanitary napkin product also the controlled sample of untreated and cool& soft finished polypropylene also selected for comparative study.

3.12 SANITARY NAPKIN PREPARATION:

The sanitary napkin was made of three layers and heat sealed by means of heat sealing machines according to the standardized measurements.

The absorbent core of bamboo web was cut according to the size of sanitary napkin using the templates. Then the web was compressed by means of web compressing machine, then the web was wrapped with the outer cover stock & leak proof layer and sealed by heat sealing machine.

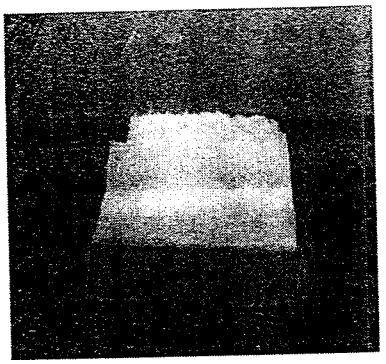


Figure:3 Napkin components

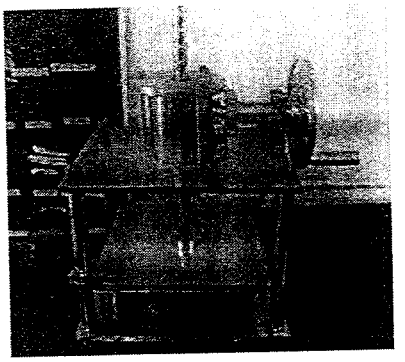


Figure:4 Compressing machine

Figure:5 Template

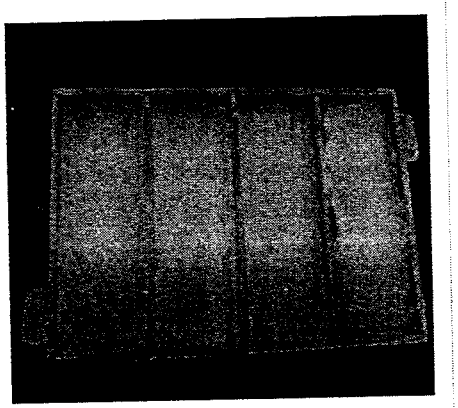


Figure:6 Fusing machine

3.13 VARIETIES OF SANITARY NAPKINS:

Varieties of sanitary napkins were made which varied in the composition of the absorbent core and outer cover stock with the following specifications:

- Stock cover / top cover(Permeable Non-woven) GSM- 15 GSM,
- Dimension -200 mm X 75 mm
- Leak proof material dimensions (polyethylene sheet)- 190 mm X 90 mm

TABLE -6 VARIETIES OF SANITARY NAPKINS

Product No	Composition of outer cover stock/ the absorbent core	Sanitary napkin sample name	Weight of absorbent core(grams)
1	Untreated Polypropylene/ Bamboo	U- PP/B	13.9
2	Untreated Polypropylene/ Wood Pulp	U-PP/WP	12.55
3	Curcuma Longa(Turmeric Leaves)herbal treated pp/ bamboo	HT- PP/B	13.18
4	Curcuma longa(Turmeric Leaves) herbal & c and s finish treated pp/ Bamboo	HT- C&S PP/B	12.98
5	Cool and Soft Finished PP/ Bamboo	C&S PP/B	12.19

4. PERFORMANCE TEST OF PREPARED SANITARY NAPKINS:

Each variety of the prepared sanitary napkins has been tested for the following:

4.1 Absorbency Test: Standard: IS: 5405-1980 A-1.2

4.1.1 Procedure:

Weigh the dry weight of the napkin and lay it on a flat level glass plate, so that the underside of the napkin is visible. Using the burette, drip the test liquid at the rate of 15ml per min on the center of sanitary napkins, from a height of 1-2mm approximately away from the burette. Immediately after noting down the end point of the absorption capacity of the pad (which is noted through the leaking of the pad on the sides), the dripping of the test liquid is stopped. Then total amount of liquid allowed to drip is noted down based on the burette readings and the values are tabulated.

Figure 7: Absorbency test apparatus

The Absorbency % was calculated using the formula:

Absorbency % = ((FTB-ITB)/ (ITB))*100

Where,

ITB- Initial weight of the napkin absorbency

FTB- Final weight of the napkin absorbency

4.2. RETENTION %, LEAK FACTOR AND DRYNESS FACTOR

4.2.1 Standard: Modified IS: 5405-1980 5.1

Procedure:

Lay the sanitary napkin on a flat level glass plate, so that the underside of the napkin is visible. Using the burette, drip the 30ml of goat blood at the rate of 15ml per min on the center of sanitary napkins, from a height of 1-2mm approximately away from the burette. After the napkin has absorbed the full amount of liquid, keep a blotting paper of known initial weight one on the top and one at the bottom of the pad and place a standard weight of 1kg for 1 min on the portion where the fluid was absorbed. At the end of loading time remove the napkin and blotting papers from the top and bottom of the pad and find out the final weight of the napkin and blotting papers.

The retention% was calculated using the formula:

Retention % = ((FBB-IBB)/ (ITB))*100

Where,

IBB- Initial weight of the napkin

FBB- Final weight of the napkin

The Leak factor was calculated using the formula:

Leak factor% = ((FTB-ITB)/ (ITB))*100

Where,

ITB- Initial weight of the top blotting paper

FTB- Final weight of the top blotting paper

The Dryness factor was calculated using the formula:

Dryness factor% = ((FBB-IBB)/ (ITB))*100

Where,

IBB- Initial weight of the bottom blotting paper

FBB- Final weight of the bottom blotting paper

RESULT&DISCUSSION

5. RESULTS & DISCUSSIONS

5.1. SELECTION OF HERBAL LEAVES BASED ON THE ANTIMICROBIAL ACTIVITY OF THE HERBAL LEAF EXTRACTS:

TABLE -7 ANTIMICROBIAL ACTIVITY ASSESSMENT TEST FOR HERBAL SOLUTIONS (SOLUTION IDENTIFICATION TEST) - AGAR DIFFUSION TEST

Zone of inhibition (mm)												
	Turmeric leave				**Poovarasu tree leaves**				**Aloe vera leaves**			
Bacteria & fungi	**Anti-biodic disc**	**50 µl**	**100 µl**	**150 µl**	**Anti-biotic disc Disc**	**50 µl**	**100 µl**	**150 µl**	**Anti-biodic disc Disc**	**50 µl**	**100 µl**	**150 µl**
Staphylococcal aureus	**15**	**18**	**20**	**25**	**13**	**8**	**13**	**15**	**15**	**15**	**20**	27
Escherichia coli	11	13	16	17	13	8	10	12	15	13	18	25
Pseudomonas aeruginosa	11	14	25	27	10	11	20	26	10	20	25	28
Candida albicans	10	12	20	25	10	13	18	22	10	12	15	20

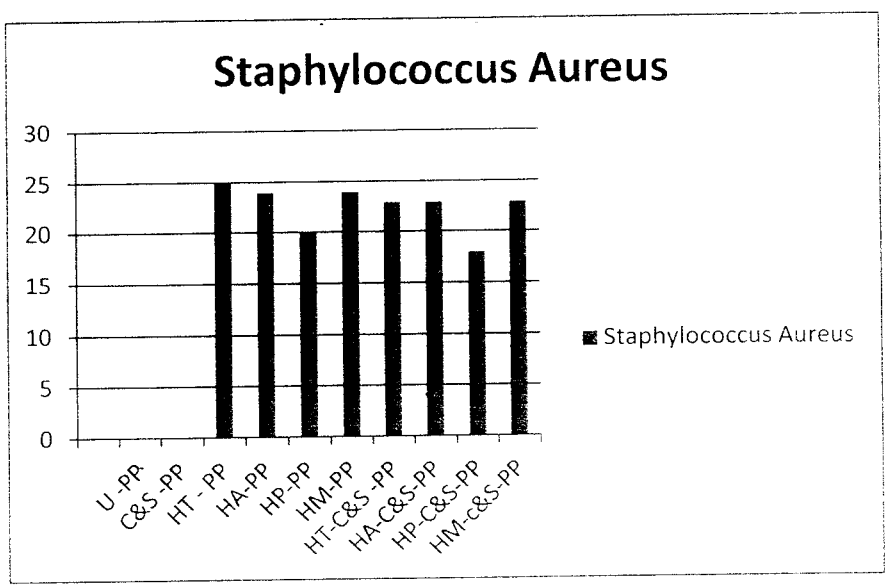
From the above table, it is clearly shown that the solution extracted from the turmeric leaves rank first, followed by Aloe vera leaves and Poovarasu tree leaves and were the best when compared to the other herbs. The best zone of inhibition is taken by comparing the zone with the antibiotic's zone of inhibition.

5.2. TESTING OF ANTIMICROBIAL ACTIVITY OF THE POLYPROPYLENE COVERSTOCKS APPLIED WITH THE SELECTED HERBAL EXTRACTS

TABLE -8: QUALITATIVE STUDIES OF ANTI-microbial ACTIVITY AGAINST SELECTED MICROBES

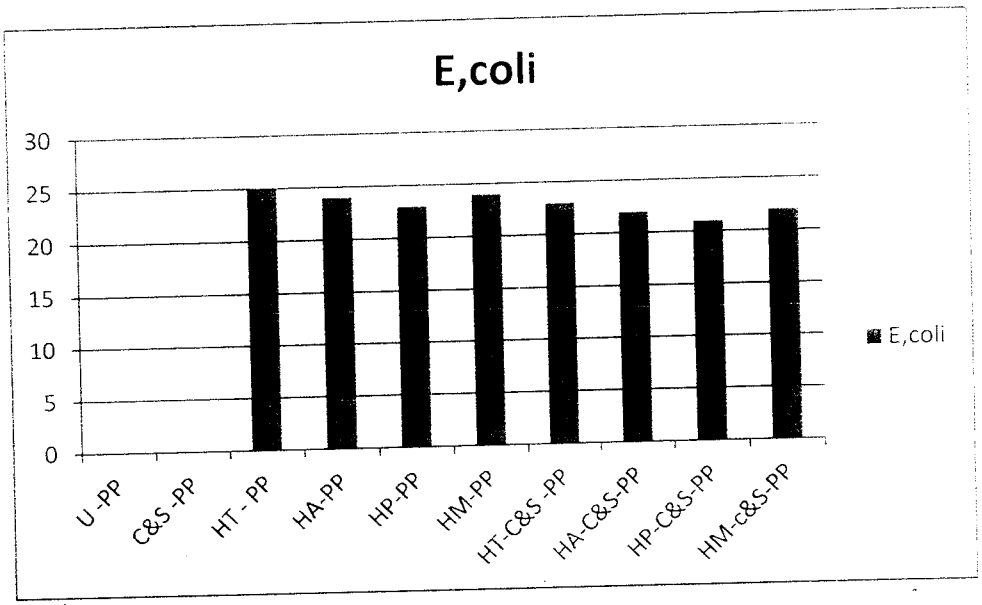
		Zone of Inhibition (mm)			
S.No.	Samples	**Staphylococcus Aureus**	**Escherichia Coli**	**Pseudomonas Aeruginosa**	**Candida Albicans**
1	U –PP	0	0	0	0
2	C&S –PP	0	0	0	0
3	HT - PP	25	25	25	24
4	HA-PP	24	24	24	23
5	HP-PP	20	23	22	22
6	HM-PP	24	24	24	23
7	HT-C&S -PP	23	23	23	22
8	HA-C&S-PP	23	22	22	22
9	HP-C&S-PP	18	21	20	20
10	HM-C&S-PP	23	22	21	22

FIGURE -8: ANTI-BACTERIAL ACTIVITY AGAINST STAPHYLOCOCCUS AUREUS



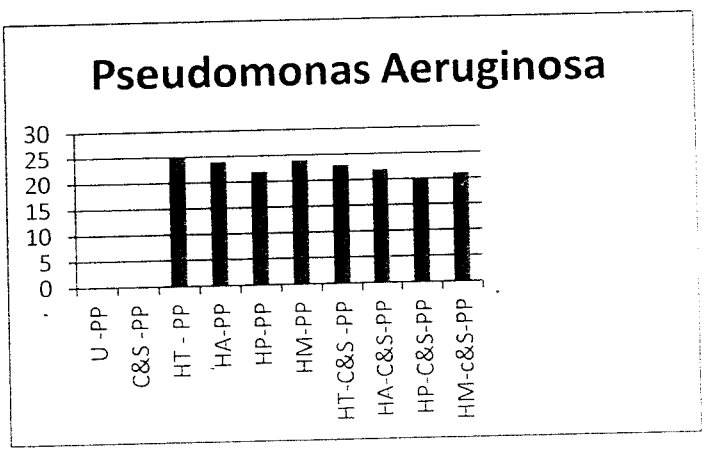
From the above figure, it clearly shows that the HT - PP cover stock has better anti microbial activity when compared to other treated fabric against Staphylococcus Aureus.. The HT - PP finished polypropylene sheet have better zone of inhibition followed by HA - PP treated and HM-PP outer cover stock sheet.

FIGURE – 9:ANTI-BACTERIAL ACTIVITY AGAINST E. COLI



From the above figure, it clearly shows that the HT - PP cover stock have better anti microbial activity when compared to other treated fabric against Escherichia Coli .The HT - PP finished polypropylene sheet have better zone of inhibition followed by HT - PP treated and HM-PP treated outer cover stock sheet.

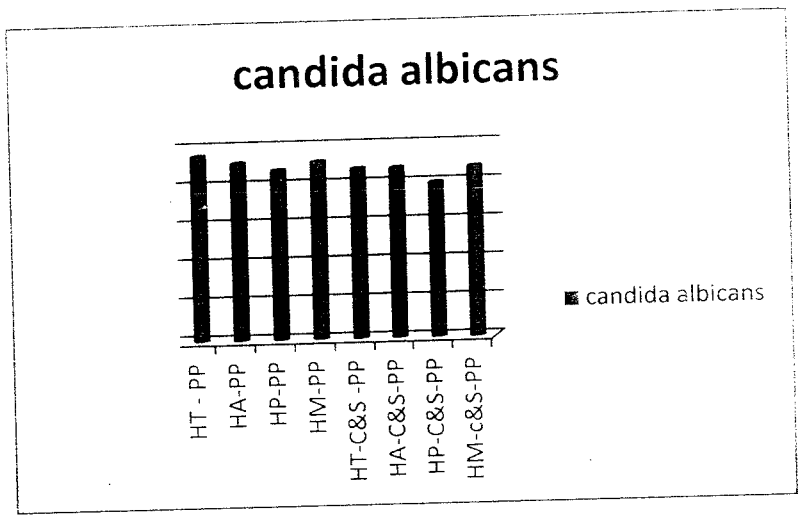
FIGURE –10:ANTI-BACTERIAL ACTIVITY AGAINST PSEUDONAS AERUGINOSA



From the above figure, it clearly shows that the HT – PP treated cover stock has better anti microbial activity when compared to other treated fabric against Pseudomonas Aeruginosa .

The HT – PP finished polypropylene sheet have better zone of inhibition followed by aloe HA – PP treated and HM – PP treated outer cover stock sheet.

FIGURE –11: ANTI-FUNGI ACTIVITY AGAINSTCANDIDA ALBICANS



From the above figure, it clearly shows that the HT-PP treated cover stock has better anti microbial activity when compared to other treated fabric against candida albicans. The HT-PP finished polypropylene sheet have better zone of inhibition followed by HA-PP treated and HM-PP treated outer cover stock sheet.

5.3. TESTING THE COMFORT PROPERTIES OF UNFINISHED AND FINISHED POLYPROPYLENE COVER STOCK SHEETS

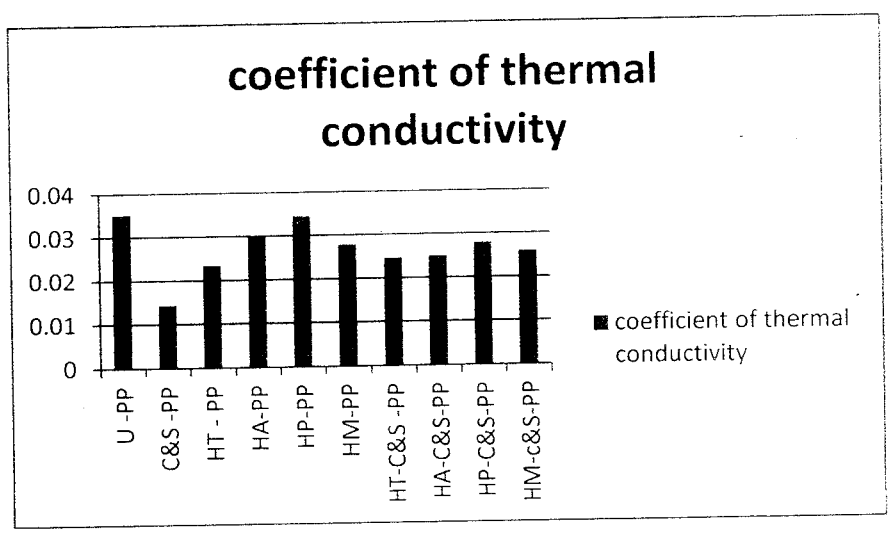
5.3.1 TESTING THE COMFORT PROPERTIES OF COVER STOCK SHEETS:

5.3.2 Thermal Conductivity Test:

TABLE -9: THERMAL CONDUCTIVITY TEST

S.No	Samples name	Coefficient of thermal conductivity (watt/ metre/ kelvin)
1	U -PP	0.03520
2	C&S -PP	0.01438
3	HT - PP	0.0234
4	HA-PP	0.0302
5	HP-PP	0.0345
6	HM-PP	0.0278
7	HT-C&S -PP	0.02466
8	HA-C&S-PP	0.025
9	HP-C&S-PP	0.028
10	HM-c&S-PP	0.026

FIGURE -12 COEFFICIENT OF THERMAL CONDUCTIVITY



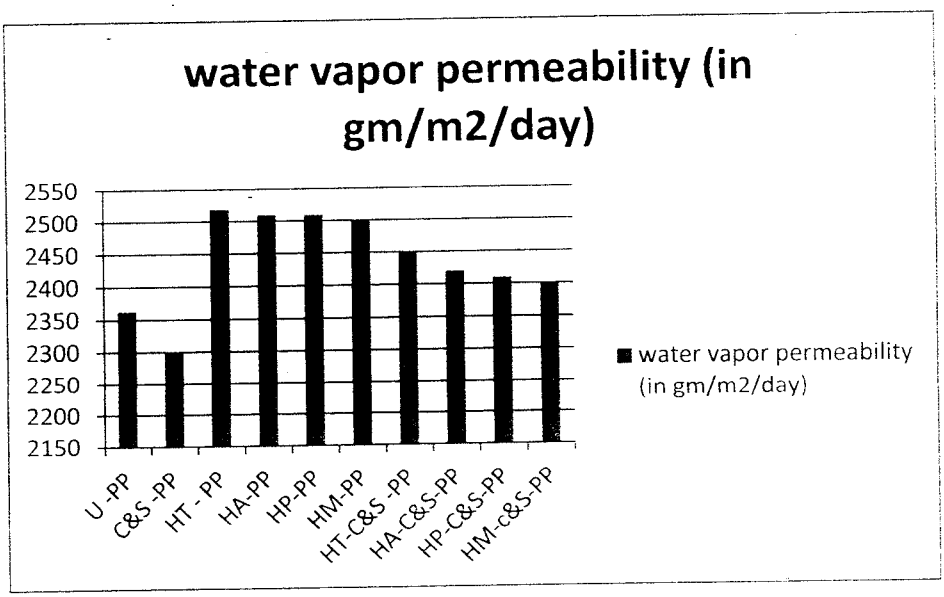
Lower values of the Coefficient of thermal conductivity are desirable. From the above figure, it is observed that thermal conductivity of HT-PP and HT- C&S –Pp outer cover stock have good thermal conductivity property when compared to control sample of C&S-PP samples. The result shows both HT-PP and HT- C&S –PP samples have good thermal conductivity property.

5.3.3 WATER VAPOUR PERMEABILITY TEST RESULT:

TABLE -10 WATER VAPOUR PERMEABILITY TEST

S.No	Samples name	Water vapor permeability (in gm/m2/day)
1	U -PP	2363.31
2	C&S -PP	2300.50
3	HT - PP	2519.04
4	HA-PP	02510.04
5	HP-PP	2509.50
6	HM-PP	2500.09
7	HT-C&S -PP	2450.29
8	HA-C&S-PP	2420.50
9	HP-C&S-PP	2410.19
10	HM-c&S-PP	2400.29

FIGURE -13 WATER VAPOUR PERMEABILITY TEST



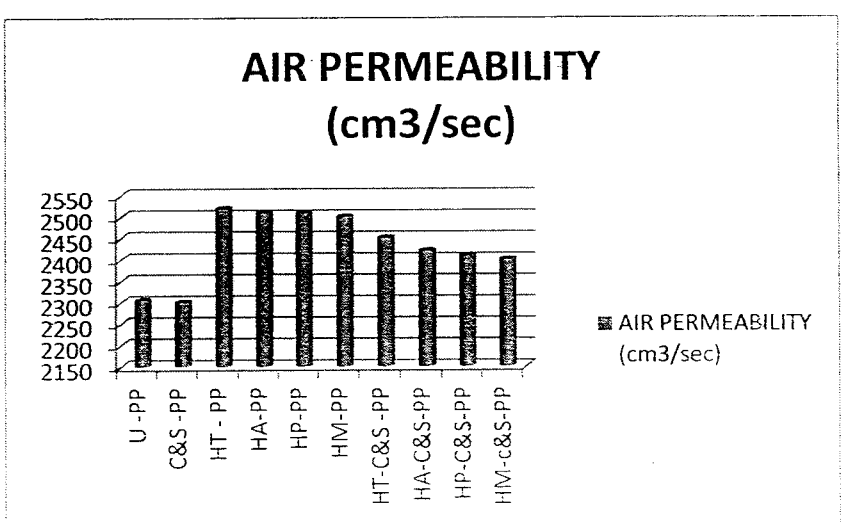
From the above figure , it is observed that HT-PP sheet have better water vapour permeability when compared to other treated & untreated polypropylene sheet. The HT-PP sheet has better Water vapour permeability properties and it improves the comfort properties.

5.3.4 AIR PERMEABILITY TESTER:

TABLE -11 AIR PERMEABILITY TEST

Samples name	Air permeability (cm3/sec)
U -PP	2305.5
C&S -PP	2300.50
HT - PP	2519.04
HA-PP	02510.04
HP-PP	2509.50
HM-PP	2500.09
HT-C&S -PP	2450.29
HA-C&S-PP	2420.50
HP-C&S-PP	2410.19
HM-c&S-PP	2400.29

FIGURE -14 AIR PERMEABILITY TESTER



From the above figure, it is observed that HT-PP finished sample have better air permeability when compared to U-PP Sheet followed by HA-PP and HP-PP outer cover stock.

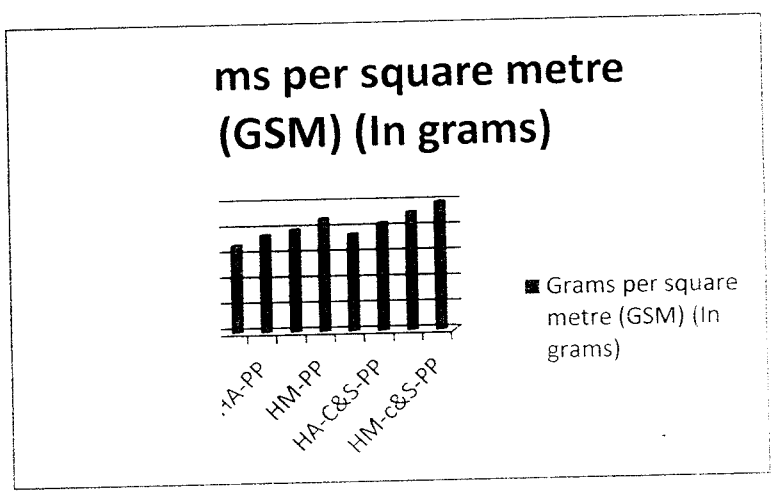
5.4 TESTING THE DIMENSIONAL PROPERTIES OF COVER STOCK SHEETS:

5.4.1 POLYPROPYLENE OUTER COVER SHEET GSM TEST METHOD:

TABLE -12 GSM TEST

S.no	Samples name	Grams per square metre (GSM) (in grams)
1	U -PP	15
2	C&S -PP	15.05
3	HT - PP	15.07
4	HA-PP	15.09
5	HP-PP	15.10
6	HM-PP	15.12
7	HT-C&S -PP	15.09
8	HA-C&S-PP	15.11
9	HP-C&S-PP	15.13
10	HM-c&S-PP	15.15

FIGURE -15 GSM TEST



From the above figure, it is observed that there is no big change in Grams per square metre (GSM) of treated polypropylene sheet when compared to untreated polypropylene sheet. There is a fraction of change in gsm of fabric between treated & untreated polypropylene.

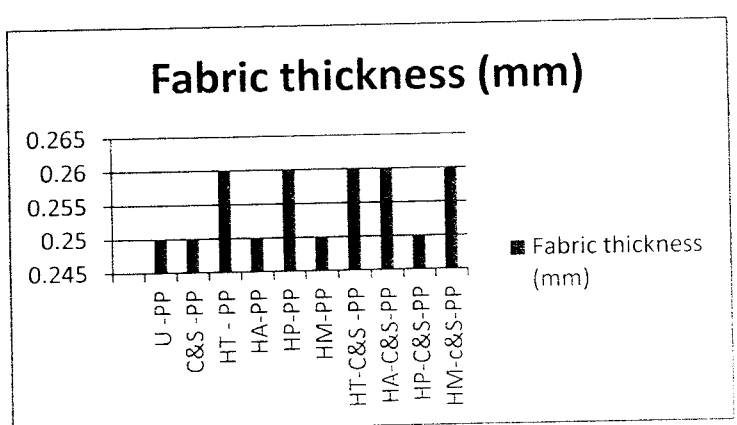
5.4.2 FABRIC THICKNESS TEST REULTS:

TABLE -13 FABRIC THICKNESS TEST

S.no	Samples name	Fabric thickness (mm) (in grams)
1	U -PP	0.25
2	C&S -PP	0.25
3	HT - PP	0.26
4	HA-PP	0.25
5	HP-PP	0.26
6	HM-PP	0.25
7	HT-C&S -PP	0.26
8	HA-C&S-PP	0.26
9	HP-C&S-PP	0.25
10	HM-c&S-PP	0.26

From the above figure, it is observed that there is no big change in thickness of treated polypropylene sheet when compared to untreated polypropylene sheet. There is a fraction of change between treated & untreated polypropylene. So this property will not affect any end uses.

FIGURE -16 FABRIC THICKNESS TEST



5.4.3 TENSILE STRENGTH TEST:

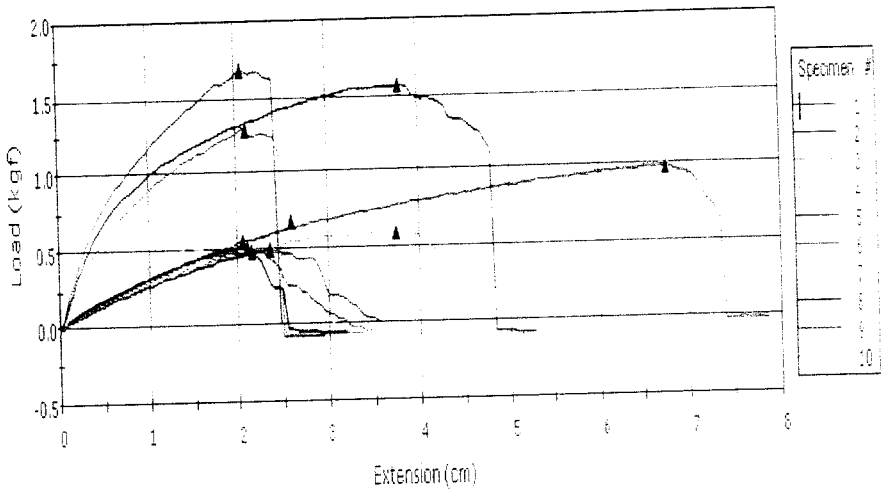
1. U -PP
2. C&S –PP
3. HT – PP
4. HA-PP
5. HP-PP
6. HM-PP
7. HT-C&S –PP
8. HA-C&S-PP
9. HP-C&S-PP
10. HM-c&S-PP

TABLE -14 TENSILE STRENGTH TEST

Sample name.	Maximum load	Extension at Maximum Load
U -PP	0.99	6.75
C&S -PP	1.67	2.05
HT - PP	1.29	2.10
HA-PP	0.60	3.75
HP-PP	1.56	3.80
HM-PP	0.49	2.15
HT-C&S -PP	0.55	2.05
HA-C&S-PP	0.52	2.10
HP-C&S-PP	0.50	2.35
HM-c&S-PP	0.68	2.60
MAXIMUM	1.67	6.75
MINIMUM	0.49	2.05
MEAN	0.88	2.97
COEFFICIEN	52.46315	50.17539
STANDARD DEVIATION	0.46359	1.49021

Tensile strength is important property for any textile material. From the above table it is observed that the tensile strength of HT – PP and HT-C&S –PP sheet have more tensile strength. So after treatment the tensile strength of outer cover stock was increased.

FIGURE -17 TENSILE STRENGTH TEST



5.4.4 SPECTROPHOTO METER COLOUR ANALYSIS

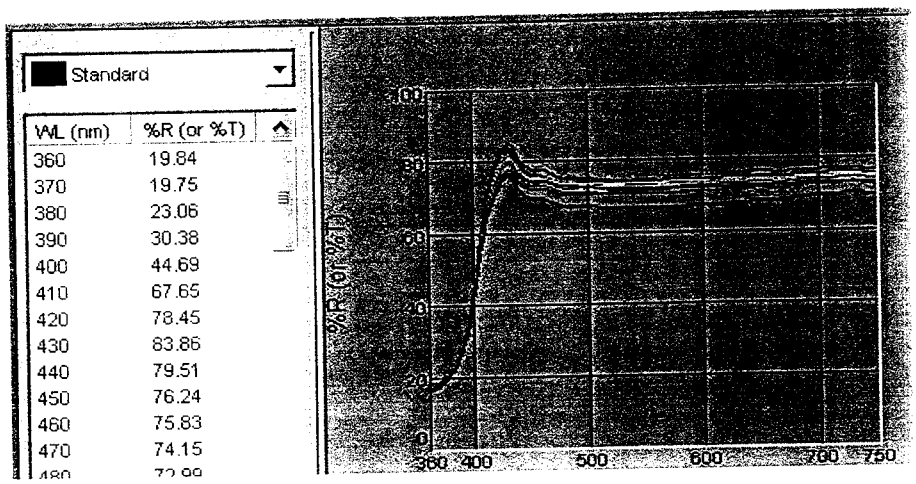
TABLE -15 SPECTROPHOTO METER

Standard Name I	12	I [a*]	V CA	/h°	
Standard	88.09	1.63	-3.53 3.89	29476	
Trial Name	DL	Da	Db DC	OH	DEcinc
Cool & soft	-0.26	-0.23	1.03 Y -1.02 D	0.25 R	/ .51
Herbal 1	1.19 L	--1.130	4.62 Y -2.69 D	3 92 R	6.02
Herbal 2	0.66 L	-0.26 G	2.24 Y -2.00 D	1.03 R	167
Herbal 3	1.40L	-19	0.97'? -0.95D	0.26R	1.25
Herbal 4	0.77 L	-0.46 G	2.26 -217 D	0.80 R	210
Herbal + Cool & Soft	-0.64D	-0.57 G	232 -228 D	0.71 R	2.79
Herbal + Cool & Soft 2	--0.60	-0.37 G	1.38 'I -1 .40	031 R	/ .66
Herbal + Cool & Soft 3	1 L	-0.27 G	0.82 -0.86 D	010 R	1.07
Herbal + Cool 8, Soft 4	011 L	-0.46 G	1.85 -1.84 D	0.49 R	220

In spectrophotometer colour analysis, the untreated standard sample is compared with treated sample for analyze the colour change in treated material. From the above table, it is

observed that there is a limited colour change in treated material when compared to standard sample and it doesn't affect the end use of outer cover stock sanitary napkin.

FIGURE -12 SPECTROPHOTO METER COLOUR ANALYSIS



5.5 WICKABILITY TEST RESULT:

5.5.1 SELECTION OF OUTER COVER STOCK FOR WICKABILITY TEST

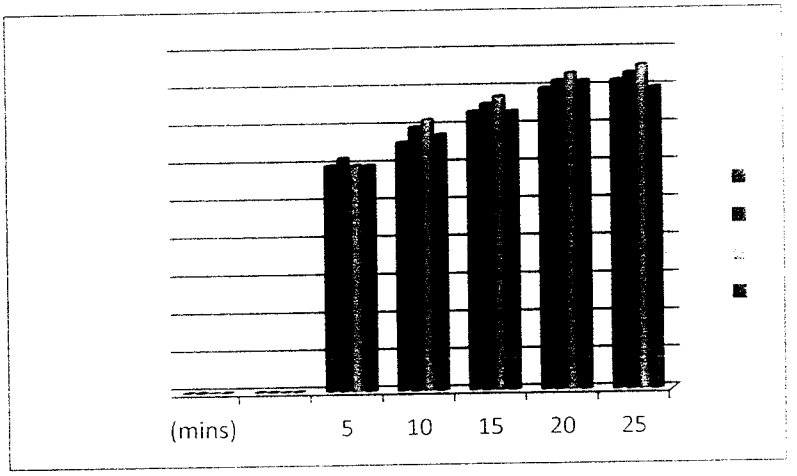
As per end result obtained from testing the comfort and dimensional properties the outer cover stock of U –PP , C&S –PP , HP-PP , HT-C&S –PP was selected based on having good comfort and dimensional properties.

TABLE -16 WICKABILITY TEST

S.NO	U –PP	C&S –PP	HT-PP	HT-C&S –PP
5	3	3.1	3	3
10	3.3	3.5	3.6	3.4
15	3.7	3.8	3.9	3.7
20	4.0	4.1	4.2	4.1
25	4.1	4.2	4.3	4.0

From the above figure , it is observed that **HT-PP and HT-C&S –PP** finished sample have better wickability when compared to untreated polypropylene sheet. The treated polypropylene sheets have better wickability properties and it improves the wickability.

FIGURE -18 WICKABILITY TEST

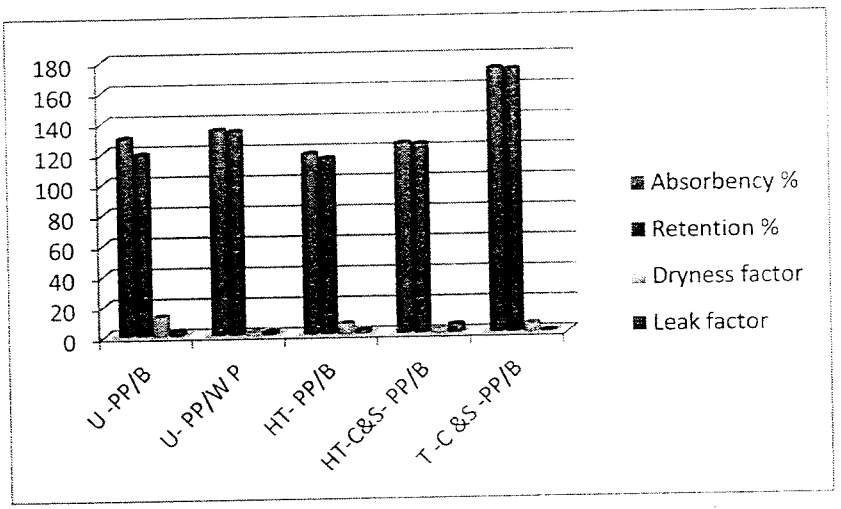


5.6. ANALYSIS OF THE PERFORMANCE PROPERTIES OF THE ASSEMBLED SANITARY NAPKINS.

TABLE -17 RETENTION%, LEAK FACTOR, DRYNESS FACTOR

S.No	Napkin sample	Absorbency %	Retention %	Dryness factor	Leak factor
1	U -PP/B	129.72	118.95	12.57	3.02
2	U- PP/W P	134.58	133.55	1.33	1.81
3	HT- PP/B	118.36	115.10	6.62	1.96
4	HT-C&S- PP/B	124.37	123.87	2.60	5.44
5	T -C &S -PP/B	172.93	172.03	5.29	0.54

FIGURE -19 RETENTION%, LEAK FACTOR, DRYNESS FACTOR



Absorption %: As per compared with the controlled samples the absorbency % of sanitary napkin were ranked number 1 as T -C &S -PP/B followed by HT-C&S- PP/B and HT-PP

Retention %: It is observed that sanitary napkin made from T -C &S -PP/B sample have better retention % than the napkin made from U -PP/B and U- PP/W P controlled sample followed by HT-C&S- PP/B. Result shows the napkins made from treated T -C &S -PP/B have good retain property.

Dryness factor: From the table , It is observed that sanitary napkin made from HT- PP/B have dryness factor than than the napkin made from U- PP/W P followed by HT-C&S- PP/B and T - C &S -PP/B . Result shows the napkins made from HT- PP/B composition dried quickly when compared to U- PP/W P.

Leak factor: From the table, It is observed that sanitary napkin made T -C &S -PP/B have better leak proof factor than the napkin made from U -PP/B composition followed by HT- PP/B. Result shows The napkins made from T -C &S -PP/B composition doesn't leak the liquid when compared to U –PP. It gives good leak proof properties to sanitary napkin.

- T -C &S -PP/B napkin has given a better performance as a sanitary napkin when analyzing all the 4 performance properties, when compared to the other varieties of sanitary napkins. The dryness factor alone is higher but it has the least leak factor and the highest retention %.
- Both the samples HT-C&S- PP/B and HT- PP/B have shown lesser absorbency, which may be due to the fact that the herbal treatment might have reduced the absorbency, but they have still shown acceptable ranges of absorbency and have shown better retention %.

5.7 COSTING OF PREPARED SANITARY NAPKIN:

5.7.1OVERALL COST OF SANITARY NAPKIN

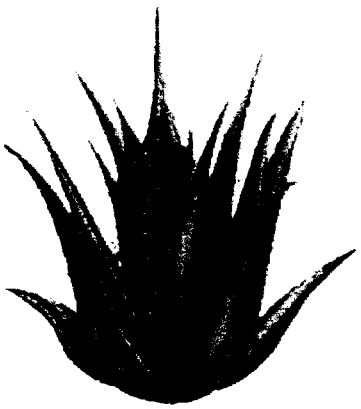
Elements	Web formation	Finishing herbal	Finishing Cool& soft	Cost of cover stock and leak proof	Cmts	Fiber	
						bamboo	Wood pulp
Per kg	15	20	20	44	88	150	100
Per napkin	0.17	0.25	0.25	0.50	1	0.15	0.13

5.7.2 COST OF SANITARY NAPKINS FOR VARIOUS COMPOSITIONS OF OUTER COVER STOCK/ THE ABSORBENT CORE

S .No	Composition of outer cover stock/ the absorbent core	Per pad
1	Untreated Polypropylene/ Bamboo (U-PP)	1.82
2	Untreated Polypropylene/ Wood Pulp (U-WP)	1.80
3	Curcuma Longa(Turmeric Leaves)herbal treated pp/ bamboo (HT-PP/B)	2.07
4	Curcuma longa(Turmeric Leaves) herbal & cool and soft finish treated pp/ Bamboo (HT-C&S –PP/B)	2.32
5	Cool and Soft Finished PP/ Bamboo (C&S- PP/B)	2.17

LIST OF PLATES

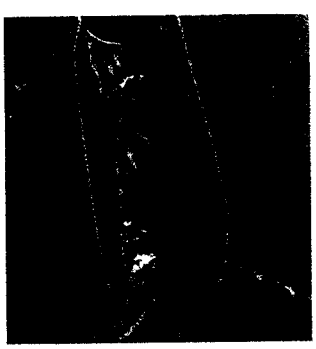
PLATE -1 HERBALS USED



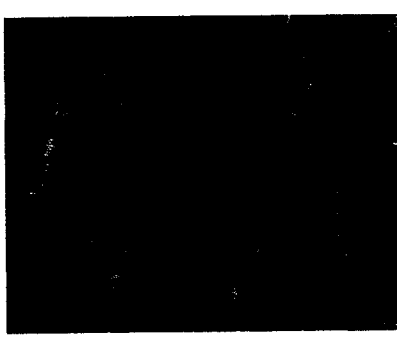
Aloe vera leaves

Poovarasu tree leaves

Turmeric leave



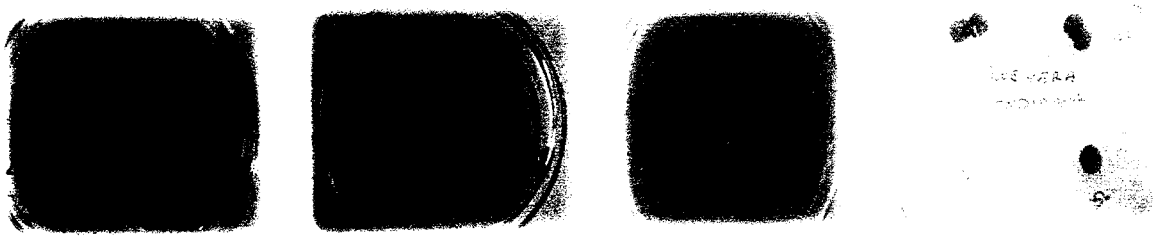
Aloe vera gel



Neem seed oil

PLATE -2 OPTIMIZATION OF EXTRACTED HERBAL RECIPE FOR ANTI-MICROBIAL ACTIVITY

1. Poovarasu Tree Leaves (Thespesia populnea)



2. Turmeric Leaves (Curcuma longa)

3. Aloe Vera leaf (Barbados Aloe)

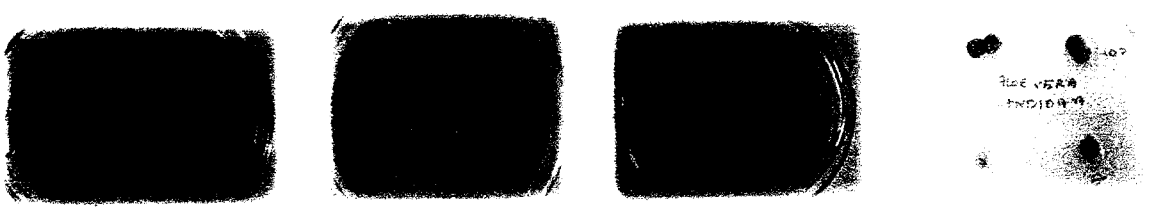
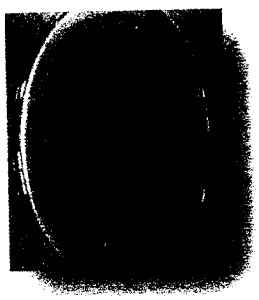
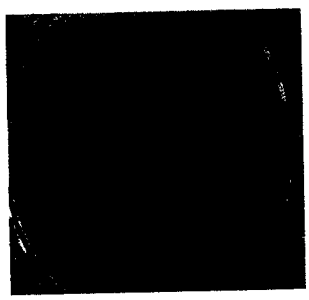
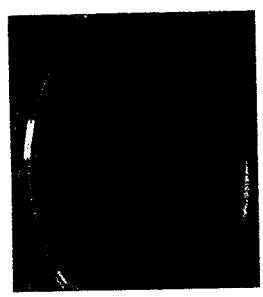
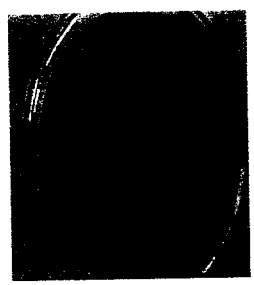


PLATE -3 QUALITATIVE STUDIES OF ANTI- MICROBIAL ACTIVITY OF TURMERIC

Herbal treated polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

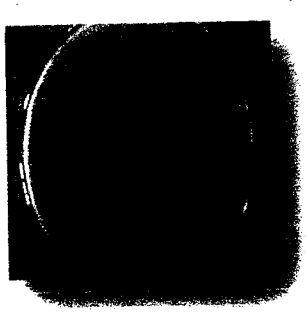
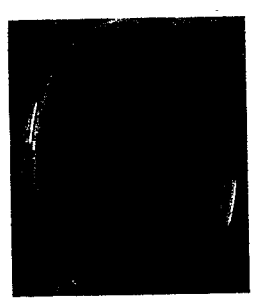
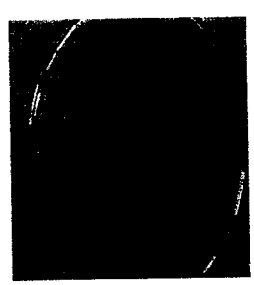
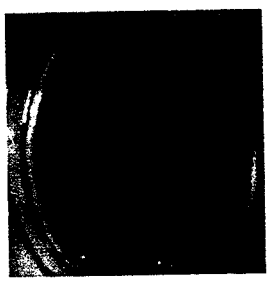
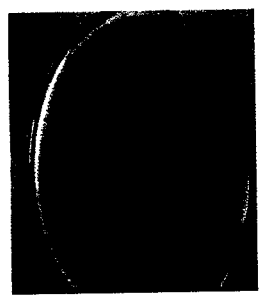
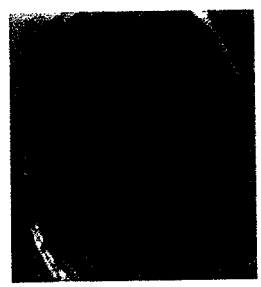
Herbal+ cool & soft finished polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

PLATE -2 QUALITATIVE STUDIES OF ANTI-BACTERIAL ACTIVITY OF ALOE VERA

Herbal treated polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

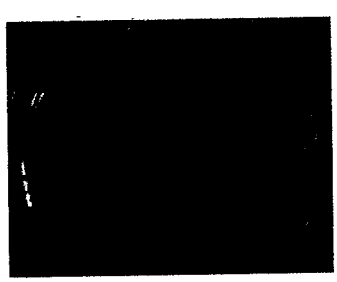
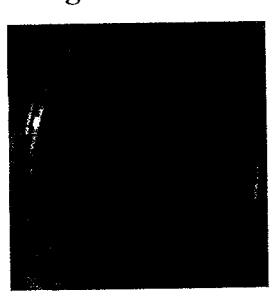
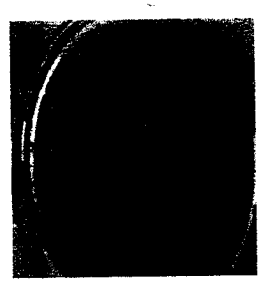
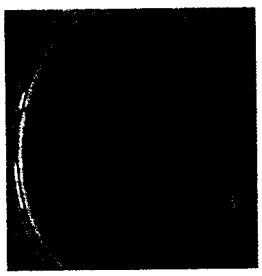
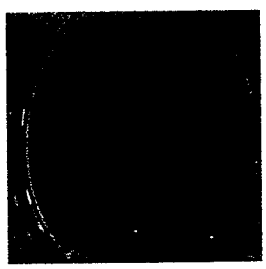
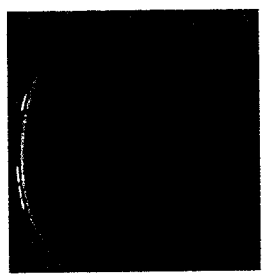
Herbal+ cool & soft finished polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

PLATE -4 QUALITATIVE STUDIES OF ANTI-BACTERIAL ACTIVITY OF MIXED HERBAL SOLUTION

Herbal treated polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

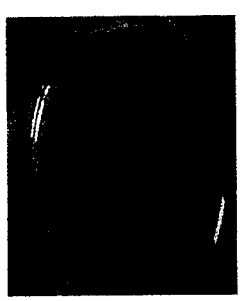
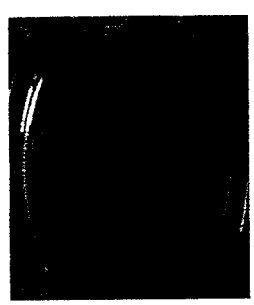
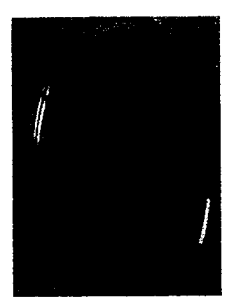
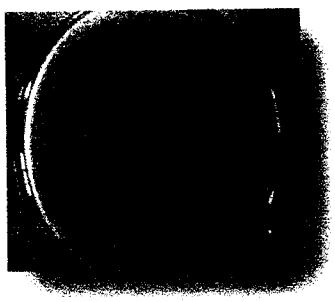
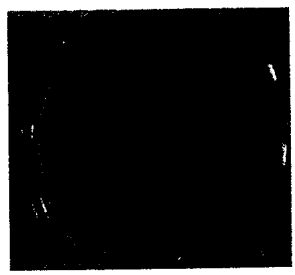
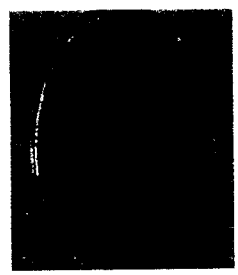
Herbal+ cool & soft finished polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

PLATE -3 QUALITATIVE STUDIES OF ANTI-MICROBIAL ACTIVITY OF POOVARASU

Herbal treated polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

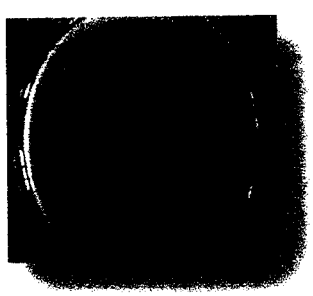
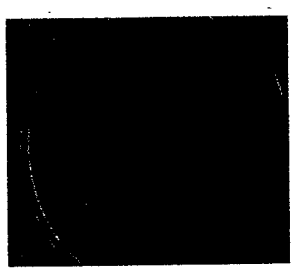
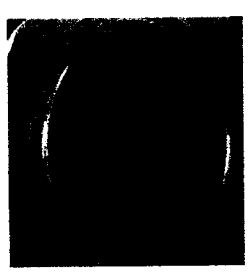
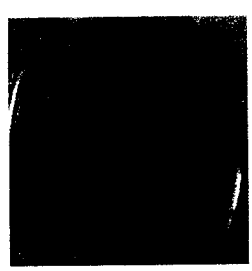
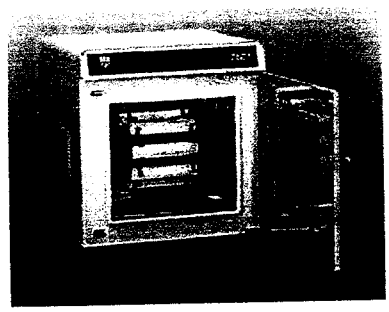
Herbal+ cool & soft finished polypropylene sheet			
Staphylococcal aurous	Escherichia coli	Pseudomonas aeruginosa	Candida albicans
			

PLATE -5 MACHINERIES USED FOR ANTI- MICROBIAL TESTING

LAMINAR AIRFLOW CHAMBER

INCUBATOR CHAMBER



MACHINERIES USED FOR FINISHING

PADDING MANGLE

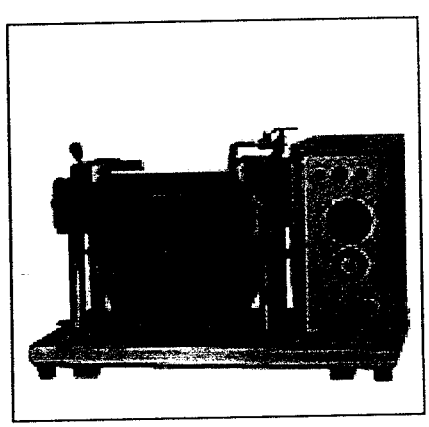
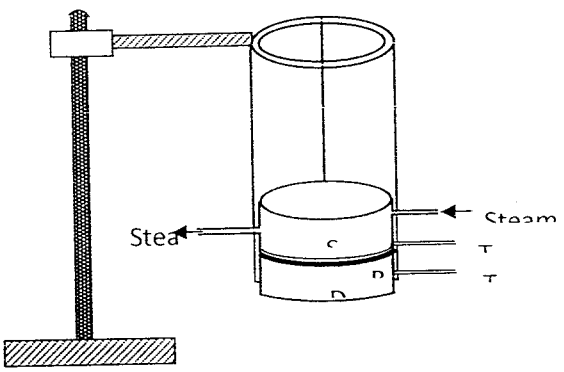


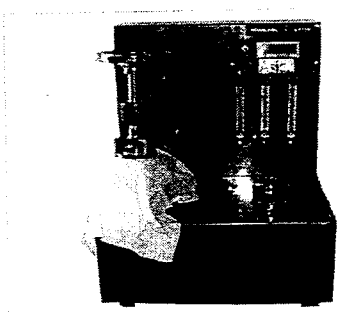
PLATE- 6 MACHINERIES

USED COMFORT PROPERTIES TESTING

LEE'S DISC APPARATUS (THERMAL CONDUCTIVITY)



AIR PERMEABILITY TESTER



WATER VAPOUR PERMEABILITY TESTER

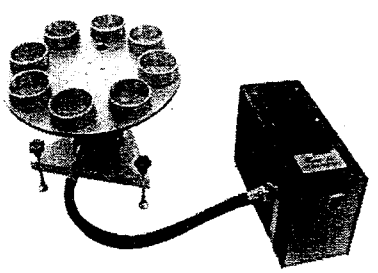
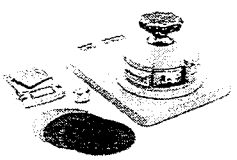


PLATE-7 MACHINERIES USED PHYSICAL PROPERTIES TESTING

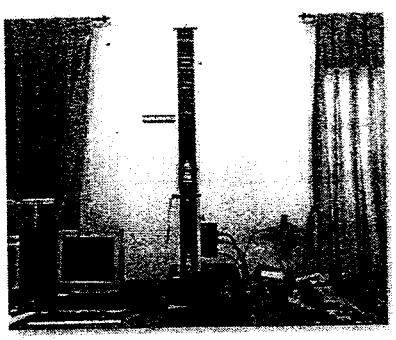
FABRIC THICKNESS TESTER

GSM CUTTER



WEIGHING BALANCE

INSTRON TENSILE STRENGTH TESTER



SPECTROPHOTOMETER

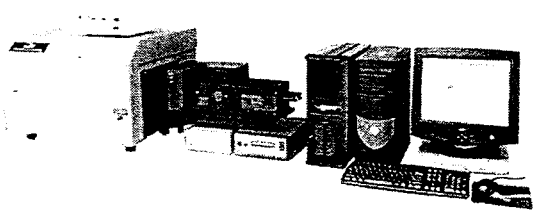
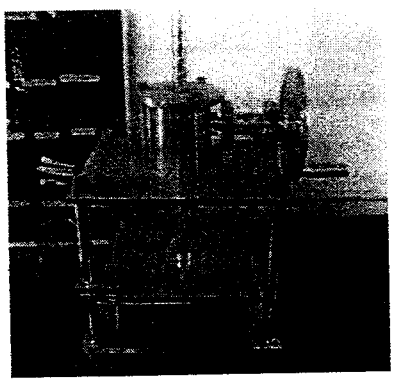


PLATE-8 MACHINERIES USED FOR SANITARY NAPKIN PREPARATION

WEB COMPRESSING MACHINE



HEAT SEALING MACHINE

CONCLUSION

6. CONCLUSION

- The herbs used for finishing sanitary napkin polypropylene outer cover stock should have anti-microbial properties and it controls the formations of rashes during menstruation.
- A variety of herbs were identified which have anti-microbial properties were procured .The procured herbs were extracted into solution and tested for its anti-microbial activity. From this the herbs have better anti-microbial activity were selected and applied on outer cover stock of sanitary napkin. The treated fabric was tested for its anti-microbial activity.
- Procedures and parameters have been standardized for applying the extract solution on the outer cover stock of the sanitary napkins.
- It is evident that moisture content% and moisture regain % of bamboo fibre selected for preparation of absorbent core is higher than wood pulp.
- Finishing methods has been optimized for the various selected herbs.
- With the anti-rash finish the cool& soft finish also applied in order to improve the functionality of sanitary napkin.
- Based on comparison of dimensional propertieswith controlled sample the HT-PP sample ranked as no.1 followed by HT C&S and HA-PP
- Based on comparison of comfort properties with controlled sample the HT-PP sample ranked as no.1 followed by HT C&S and HA-PP
- Cool& soft finish applied with the herbal finish improves the comfort & physical properties of sanitary napkin.
- **Absorption %:** As per compared with the controlled samples the absorbency % of sanitary napkin were ranked number 1 as T -C &S -PP/B followed by HT-C&S- PP/B and HT-PP
- **Retention %:** As per compared with the controlled samples the Retention % of sanitary napkin were ranked number 1 as T -C &S -PP/B followed by HT-C&S- PP/B and HT-PP
- **Dryness factor:** As per compared with the controlled samples the Retention % of sanitary napkin were ranked number 1 as HT-PP followed by T-C&S- PP/B and HT-C&S- PP/B

- **Leak factor:** As per compared with the controlled samples the Retention % of sanitary napkin were ranked number 1 as T-C&S- PP/B and followed by HT-PP and HT-C&S-PP/B
- T -C &S -PP/B napkin has given a better performance as a sanitary napkin when analyzing all the 4 performance properties, when compared to the other varieties of sanitary napkins. The dryness factor alone is higher but it has the least leak factor and the highest retention %.
- Both the samples HT-C&S- PP/B and HT- PP/B have shown lesser absorbency, which may be due to the fact that the herbal treatment might have reduced the absorbency, but they have still shown acceptable ranges of absorbency and have shown better retention %.

7. FURTHER SCOPE OF THE PROJECT:

- It is easy to go for bulk production. Because the herbs used for anti-rash finish is easily available in local area.

- In this project, we have selected only few herbs for finishing. A variety of herbs which is available for medicinal purpose could also be studied for this purpose of applying anti-rash finish.

- Instead of bamboo, eco- friendly fibers with higher moisture content could be taken for similar study in the absorbent core.

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