Bangladesh University of Textiles

Report On Project Work

Title

A Sustainable Approach: A Scope of Using the Textile Cotton Wastage in Hygiene Product (Sanitary Pad) Manufacturing

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Abstract

Bangladesh being the second biggest garment exporter globally, it is obvious that its garment industry produces a large quantity of waste fabric (jhoot) the amount of wastage is about 351,000 tons annually in Bangladesh. In Bangladesh less than 5% waste is recycled which basically used in post-consumer waste (PCW) yarn, matress, paper, handcrafts manufacturing and small amount of waste is exported. But most of the garment waste is disposed which causes landfill and environmental pollutions. For instance, waste clothes take plenty of time to mix with soil, causing landfill problems. Besides, some people burn these thrown away clothing materials in order to reduce solid waste, which instead causes carbon emission.

In modern world every country is aware about women personal hygiene. But in third world like our's are not conscious about it. In our country, only 20% of women use sanitary napkins since the available pads in the market are costly & lack of awareness. Most of them use unhygienic rags which causes many sexual diseases. This research is concerned with the reuse of cotton garments & other solid textile waste collected from spinning, knitting, weaving & garment sections of textile industries are used as a raw material which is used in hygiene product like sanitary pad and diaper manufacturing.

Keywords: Menstrual hygiene, Textile waste management, Recycled cotton, Sanitary pad.

Chapter 1 Introduction

1.1 Background of the Project

Textile sector has become the backbone to the economy of Bangladesh as the largest source of export earnings (84%) and employment (20 million) and it grows rapidly. It has spread all over the county. It contributes 63% in GDP for the last few years. This clothing industry affords socio-economic growth rapidly in Bangladesh. The massive production of textile & clothing generates a huge amount of waste. Most of the industries do not have any idea how much waste they are producing. Most of this waste is landfilled. As much as 95 percent of all textile wastes that are in landfills is recyclable.

In 2010, global consumption of fibers amounted up to 77 million tons. Till 2018, this amount rises to 106 million tons. This massive amount of consumption causes a large amount of wastage which causes many hazardous effect on environment like soil pollution by landfill, air pollution any many more. By recycling the waste, we can reduce the harmful impact of textile waste and earn revenue around $4 billion.

Again in developing countries like Bangladesh, limited attention has been paid to the role of menstrual hygiene because of lower socio-economic status & awareness. However, the effects of this ignorance on the quality of living are substantial. During the estimated 32 reproductive years is staggering, assuming 13 menstrual cycles in a given year, with a requirement of 11 napkins per cycle, the average woman requires 4500 napkins throughout her lifetime. Because of high cost of sanitary pad this is not affordable to most of the women in our country.

In this case, by using textile waste the price of sanitary pad can be reduced and also reduce the pollution.

1.2 Aim of This Project

Textiles is the second biggest polluting industry. The different processes like cutting, bundling, sewing, finishing, printing, embroidery, etc. result in scrap waste. Among all, the cutting section produces the maximum waste. Most of the waste is disposed in open field and water source. Five percent of all global landfills is being taken up by dumped textile waste. It also causes air pollution by burning textile waste, water pollution by throwing waste in rivers and oceans.

At present, not only Bangladesh but also the entire world is so conscious about women's health and environmental protection. In our country, a large number of women, especially those from low socio-economic groups, do not use sanitary napkins since the available pads in the market are costly. They make use of old rags instead which are not comfortable or hygienic, leading to illness.

In textile industry most of the wastage is cotton based which has very good absorbency It will be effective substitute of SAP which is used in sanitary napkin production. Again textile waste material is cheaper than SAP which makes it affordable to most of the people. Using waste materials in sanitary napkin manufacturing will reduce the disposal cost, environmental pollution, protect women from many diseases which is regarding hygiene materials.

1.3 Work Layout

In this work, we tried to recycle and reuse the textile cotton waste and to make sanitary pad of different purpose from textile waste, mainly from cotton waste.

The paper is organized as follow:

- In section 1, Literature review that contains, type of textile wastage, current use, scope, the environmental issue regarding textile wastage and the ultimate objective of this study.
- In section 2, the methodology is described where there is a discussion about raw materials, chemicals and equipment's we used and procedure we follow to produce sanitary pad from wastage.
- In section 3, here is a description of the result and discussion of the study. A brief description of the test (absorption capacity test, P^H test, ability to withstand pressure after absorption test, penetration test) is given.
- In section 4, the conclusion of the study is drawn.

Chapter 2 Literature Review

2.1 Textile Wastage

Waste is considered the materials which in not serving the main purpose of manufacturing. From our research we also know that up to 47% of all fiber entering the fashion value chain becomes waste throughout the myriad of different stages of production from fiber, yarn, fabric up to a garment.

Textile waste can be divided into two groups based on their source

- Post-consumer waste
- Pre-consumer waste

Post-Consumer Waste

Post-consumer waste mainly comes from the end user. Post-consumer waste can be any garments or household textile that is no longer in need of consumer either because they are worn out, damaged, outgrown, or have gone out of fashion & consumer decide to discard it.

Pre-Consumer Waste

Pre-consumer waste comes from any excess material produced during the production cycle. E.g. spinning, warping, weaving, knitting, garments cut panel, a mistake in design communication, craftsmanship problem, fabric knitting or weaving faults, wrong color or shade, machine problems, wrong pattern, wrong consumption, over production & so on.

According to the Council for Textile Recycling, post-consumer textile waste consists of all types of garments made of textiles that the owner no longer needs decides to discard. Statistics collected by the Council for Textile Recycling (1998) indicate that approximately 4.5 kilograms per capita or 1,136,363 tons of post-consumer textile waste is recycled annually. However, these 4.5 kilograms represent less than 25 percent of the total textile post-consumer waste that is generated. Franklin & Associates (1996) report that post-consumer textiles account for 4 percent by weight of the total municipal by a solid waste stream. Although the 4 percent by weight post-consumer textiles contribution to solid waste appears insignificant, it amounts to 3.6 million tons per year. Furthermore, even with a 35 percent recovery scenario assumed, post-consumer textiles waste is projected to grow at rates higher than the population growth. This will result in post-consumer textiles contributing 5 percent to the municipal solid waste stream by 2010.

2.2 Current Use of Textile (Cotton) Wastage

In this study recycled yarns from textile waste. The principle of this invention is that through processing the waste fibers differently, and by twisting the yarn made from these fibers differently, finer count yarns can be made from 100% cotton textile waste and from blends of 100% cotton and synthetic wastes; and by processing used clothing differently to open the fabric up with less breakage and better parallel alignment of fibers, post-consumer shoddy can also be used when blended with other textile fiber wastes or virgin cotton to make yarns suitable to the apparel industry. [1]

In medical cotton industry wastes were examined as a source for biogas production. The effects of inoculum addition, pretreatment of substrate, and temperature on the biogas production were taken into consideration. Results revealed that the effect of inoculum addition was more significant than the alkaline pretreatment of raw waste materials. The biogas recovery from inoculated waste materials exceeded its production from non-inoculated wastes by almost 46%. Whereby, the increase of biogas recovery from pretreated wastes was 20% higher than its production from untreated wastes. The thermophilic conditions improved the biogas yield by approximately 92%. The kinetic of bio-digestion process. [2]

In this work, there use textile-derived cellulose to reinforce recycled thermoplastic material obtained from polyethylene terephthalate (PET) drinking water bottles. Here, Cellulose has been used elsewhere as a filler as thermoplastic matrix composites. [3]

In this study focuses on the thermal characterization of an insulation material made from recycled textile fibers for building applications, which qualifies as a semi-transparent medium. This work reports on the investigation of radiative heat transfer behavior of fibrous insulation materials made from inhomogeneous recycled textile waste (i.e. featuring different fiber types and sizes) used in building applications. The radiative properties of insulation materials are identified in order to determine both the radiative thermal conductivity and effective thermal conductivity. [4]

The cotton textile was an abundant energy resource while was otherwise treated as waste. In this work, surfactants were used as catalysts in the hydrothermal carbonization (HTC) to transform cotton textile waste (CTW) into clean solid fuel. Furthermore, the conversion mechanisms of hydrothermal products during surfactant assisted HTC were preliminarily proposed. HTC is a simple and environmentally friendly method for preparing high energy density materials (hydro chars) at low temperatures, with significant advantages over pyrolysis and gasification. This process avoids energy-extensive consumption and achieves relatively low operating temperature and high conversion efficiency. In this way, it is feasible to convert CTW into clean solid fuel through HTC. Moreover, because of high cellulose crystallinity, the disruption of CTW in HTC must be carried out at a relatively high temperature and long reaction time about 260–280˚C and 2–6h to obtain the high energy density of hydro chars. However, elevating the temperature or extending the time during the HTC process would lead to excessive energy consumption. [5]

In this study the textile waste material is used as geotextile material where its used for erosion protection of slope. Textile waste was used for production of thick ropes designed for the protection of slopes against sliding and erosion. For the production of ropes, scraps of insulating materials produced from poor quality wool and scraps of nonwoven manufactured from blend of recycled fibers were applied. The ropes were installed on the slope in a disused gravel pit. Meandrical arrangement of thick ropes allowed to cast a layer of covering soil even on the steepest part of the slope. Transverse, subsequent turns of the ropes formed a system of dams, which prevented topsoil from sliding down the slope. Geotextiles not only reduced gravity landslides, but also protected the slope against damage caused by surface water erosion. Their high absorption capacity, the ropes also absorbed a significant amount of water. Thus, they prevented washing away the soil particles. As a result, during first weeks before vegetation developed, no erosive rill or grooves and other soil movements on the surface of the slope were recorded. [6]

Nonwoven material produced by hydroentangling a fiber web, comprising recycled fibers with a fiber length of between 5 and 60 mm and a fineness of between 0.1 and 20 dtex, which are constituted by fibers which are mechanically shredded or torn from nonwoven waste, textile waste or the like. The fibers are mixed with each other and possibly with new fibers in a wet-formed, foam-formed, air-laid or dry laid fiber web which is hydroentangled with sufficient energy for forming a compact absorbent material. [7]

This research is concerned with the reuse of cotton fabric waste in the paper industry, which will reduce environmental pollution & also will save the trees from being cut. Used cotton garments & other solid textile waste collected from spinning, warping, weaving & garment sections of textile industries are used as a raw material. Writing test, thickness test, tensile strength test, bursting strength test, opacity test is carried out on that. The result is promising & showed a high potential for the use of cotton wastage in the papermaking industry. Long length fiber & cotton solid waste is also used to make decorative papers. Result found in the research confirmed that the cotton waste from textile could be efficiently used for making writing papers, official or business papers, paperboards & decorative papers. [8]

The study focuses on development biodegradable quality sanitary pads at affordable prices to the schoolgirls and women, locally available cotton waste materials and anti-bacterial nanocolorants are used to prepare anti-bacterial biodegradable absorbent material suitable for sanitary napkins and diapers. Cotton fluff from loom waste was col- lected, cleaned and hydro-entangled to form absorbent sheet. The sheet shows water absorbency of more than 470%. Electrochemically synthesized natural extract (from neem and orange peel) based nanocolorants were incorporated in the material to improve their anti-bacterial ability. Further, microporous polylactic acid biodegradable sheet was used to pack the absorbent layer and its performance was tested. This antibacterial biodegradable absorbent pad would be an ideal substitute for synthetic sanitary pads considering its 100% biodegradability. This can provide a long-term viable alternative to the current practices. [9]

The primary objective of this research is to develop such a kind of sanitary napkin that will be cheaper as well as user-friendly in contrast to commercial samples. In summary, it is possible to develop sanitary pads from recycled cotton which are more affordable. There are about 4500 active garment factories in Bangladesh right now. At least 25% of resources used in those factories are discarded as wastes. Even if the factories are able to increase the efficiency and ensure optimum use of fabrics, still there will be a huge amount of unavoidable waste at different stages of production while designs are cut out in making garment items. All these wastes are subject to environmental pollution. The focus of the study is to protect the environment from textile waste by turning the waste into value added products like sanitary pad which also ensures the health of the underprivileged women in Bangladesh. [10]

Many retail sanitary napkins are available in the local market, but most of them are costly. However, poor women are unable to purchase or use high-quality sanitary napkins. Thus, a maximum of nine sanitary napkin pad samples with very cheap raw materials (natural fibers) have been produced in this study. Newly manufactured products even undergo antimicrobial treatment with natural antimicrobial agents such as Tulshi and Aloe Vera accompanied by a simple production process, which ultimately makes the product cheaper and safer for the consumer during use. [11]

Chapter 3 Methodology

3.1 Raw Materials

Cotton Wastage of Textile

From different sources, a different form of waste materials was collected. The list of collected cotton wastage sources is given below:

- Used garment: throw away garments was collected.
- Fabric pieces: fabric pieces were collected from garment section of textile industries which are left after cutting.
- Selvedge: dummy selvedge was collected from weaving section of the textile industry.
- Spinning waste collected from spinning section of the textile industry.

Figure 3-1: Solid Cotton Wastages

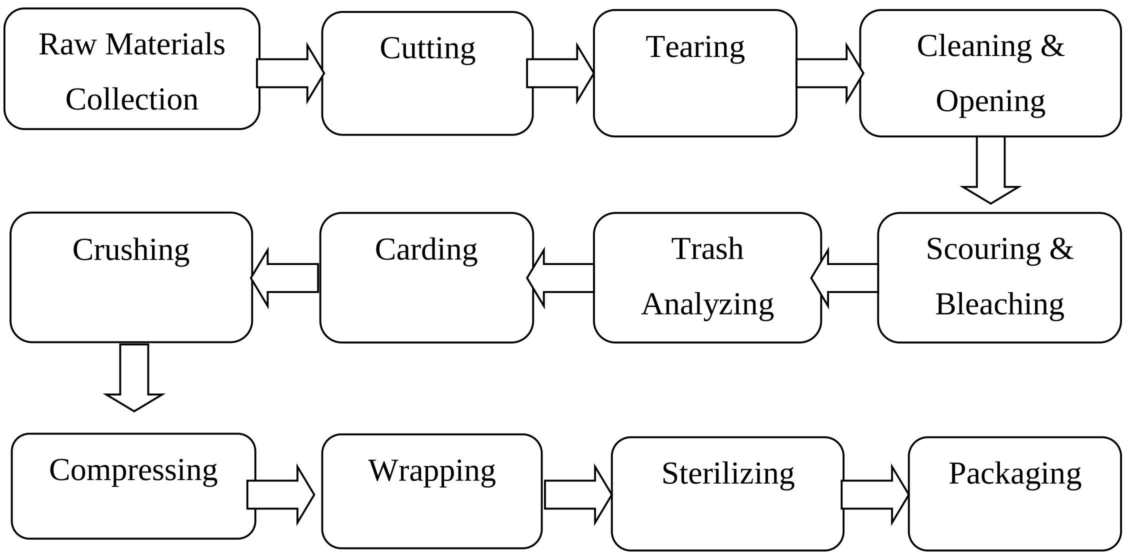
3.2 Equipment Used

Table 3-1: Types of Equipment Used

Name of the Process and test	Name of the equipment
Cutting	Cutting machine
Tearing	Tearing machine
Opening and Cleaning	Cleaning machine
Scouring and Bleaching	Beaker, Pipet, Bowl, Gas Burner, Glass rod, Thermometer, Dryer
Trash Analyzing	Trash Analyzer machine
Carding	Carding machine
Absorption Capacity Test	Bowl, Hanger, Balance
P^H Test	Beaker, P^H meter
Ability to withstand pressure after absorption test	Burette, 1kg load
Penetration Test	Liquid Strike through Time tester

3.3 Procedure

3.3.1 Process Flow Chart



3.3.2 Raw Material Processing

Opening & individualizing of the waste materials:

- After collecting the raw materials, it was sent to the recycling factory to reopen the waste materials to convert into fiber.
- In recycling factory there were two sections
  1. Recycling section
  2. Carding section

There were three types of machine in recycling zone;

Cutting Machine: The large waste materials fed into the cutting machine to make it small and facilitate the next process.

Tearing machine: After cutting the waste material the small pieces of materials went through the tearing machine where the materials were opened and converted into fiber.

Cleaning Machine: This machine cleaned the fiber.

Carding Section: The next process was carding where the cleaned fiber were individualized and straightened.

Figure 3-4: Cutting

Figure 3-3: Tearing

Figure 3-5: Opening & Cleaning

Figure 3-2: Carding

Bleaching and stripping:

The carded fibres were treated with sodium hydroxide for scouring to eliminate any harmful chemicals, dirt, germs. Then hydrogen peroxide and hydrose was used to remove dye particles and neutralizing the fibres with acetic acid to ensure the hygiene of the sanitary pads. Then dried the fibres.

Figure 3-6: Scouring & Stripping

Stripping Recipe:

- NaOH : 38 g/L
- Detergent : 10 g/L
- Wetting agent : 1 g/L
- Sequestering agent : 1 g/L
- Hydrose : 20 g/L
- Temperature : 110˚C
- Time : 1 hour

Bleaching Recipe:

- NaOH : 38 g/L
- Detergent : 10 g/L
- Wetting agent : 1 g/L
- Sequestering agent : 1 g/L
- H_2O_2 : 10 g/L
- Stabilizer : 1 g/L
- Temperature : 90˚-100˚C
- Time : 1 hour

Trash analysing and Carding: After drying the fibres fed in the trash analyser machine for individualisation of the fibre. Then carding was done to parallelization the fibres and produced the carded lap.

Figure 3-8: Trash Analyzing

Figure 3-7: Carding

3.3.3 Production Process

Crushing: In standard production line a roll of sheet input in the feeding zone which drive the material into crushing unit. In crushing unit, the materials opened and crushed into very small size.

Compressing: After crushing the material going to the compressing unit where the material placed on a standard size mould with a specific wt. Then a certain load is applied to compress the material according to the size of mould.

Wrapping: In wrapping zone the material wrapping through the non-woven fabric.In this step outer layer, inner layer, back sheet, air laid was added.

Sterilizing: To diminish the effect of microbes the material passed through a UV chamber.

Packaging: The conveyer belt drived the product into packaging zone where the final product wrapped through a packaging paper.

3.4 Produced Sample

Different components of the sample:

Figure 3-9: Back Sheet (PE)

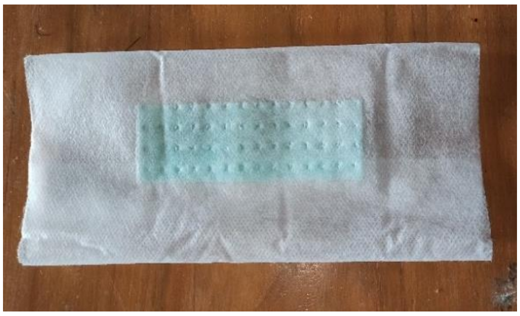


Figure 3-11: Inner layer (Nonwoven)

Figure 3-12: Outer Layer (Nonwoven)

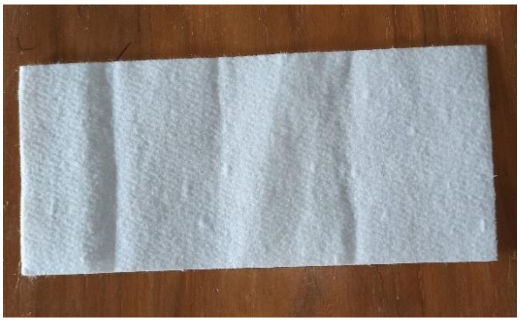


Figure 3-10: Air Laid

Figure 3-13: Filling Material (Wastage Cotton)

Final Product:

Figure 3-14: Sanitary Napkin

Table 3-2: Dimension of produced sample

Parameters	Value (average)
Length	198 mm
Width	68 mm
Thickness	14 mm
Weight	15 g

Chapter 4 Result & Discussion

4.1 Testing Process

4.1.1 Absorption Capacity Test

The maximum amount of water that can be held by the pads was determined by recording the volume of water absorbed by the pads. At first took the wt. of the sample and then immersed in demineralised (DM) water 4L for 30 min. After finishing the immersion process the sample hang vertically in a stand for 30 min to release the extra water by gravity. Took the sample wt. after 30 min. The difference between initial wt. and final wt. defined the absorption capacity of the sample.

Figure 4-1: Absorption test procedure

4.1.2 P^H Test

This test defined how acidic/basic the sample was. To measure P^H at first 0.5gm of sample cut from the core. The cut sample immersed in 100 mL DM water for 1hr. After 1hr the sample is filtered by a filter paper. Then the P^H of the was measured by the digital P^H meter.

Figure 4-2: P^H test procedure

4.1.3 Ability to Withstand Pressure After Absorption Test

This test measures the water retention ability during pressure was applied. The sample placed under the burette which carrying 1% $K_2Cr_2O_7$. Then poured 30 mL of $K_2Cr_2O_7$ within 2 min on the sample. After that 1 kg wt. was applied on the sample for next 1 minute.

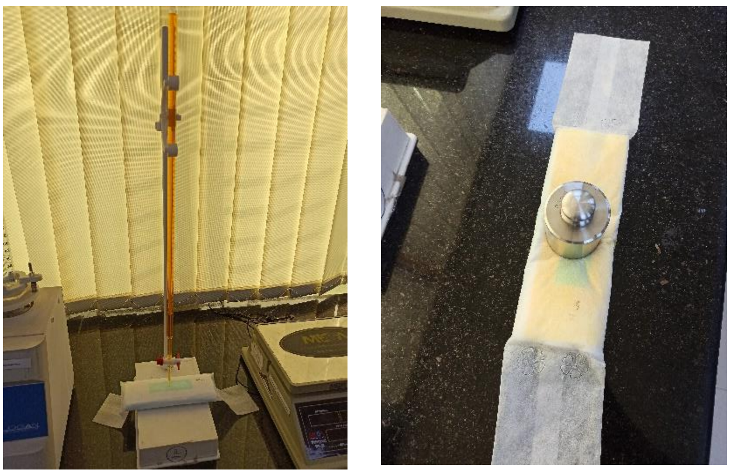


Figure 4-3: Ability to withstand pressure after absorption test procedure

4.1.4 Penetration Test

Penetration test measured the time required to penetrate the sample by water. In this test the sample placed in a liquid strike through tester. Then 20 mL of 1% saline solution poured on the sample with 3 mL/sec releasing speed. The time defined the result.

Figure 4-4: Penetration test procedure

4.1.5 Antimicrobial Test

Microbiological Examination

Apparatus and equipment

- Use apparatus and equipment complying with the relevant requirements
- Ensure compliance with the general requirements for the ingredients and for the preparation of media and reagents.

Bacteriological peptone

- Peptone 10g
- Disodium phosphate dodecahydrate 1g
- Sodium chloride 5 g
- Monopotassium phosphate 1.5g

Dissolve the ingredients in distilled water and make up to 1 L. Adjust the pH value to be 7.0 ± 0.1 after sterilization. Dispense 300 mL volumes into flasks of capacity 500 mL and sterilize by autoclaving at 121°C 2 °C for 20 min.

Plate count agar

- Agar 15 g
- Glucose 1 g
- Tryptone 5 g
- Yeast extract 2.5 g

Dissolve the ingredients in distilled water, made up to 1 liter, and adjust the pH value to 7.2 +0.2. Dispense 15 ml volumes into bottles and sterilize by autoclaving at 121°C 2°C for 20 min.

Preparation of test suspension

Transfer 300 mL of the sterile solution of bacteriological peptane (C-2.2) to a sterile wide-mouthed jar of capacity not less than 1 L and not more than 2 L. The jar shall have a mouth of diameter not less than 150 mm and not more than 250 mm, and is fitted with a thermetically closing glass or metal-and-glass lid, aseptically place the towel under test in the solution in the jar, fit the lid, agitate the contents of the jar for 2 min and then allow the jar to stand for 10 min. Repeat this agitating and standing procedure twice more. Aseptically remove about 100 ml of the test suspension for testing as described below,

Total viable bacterial count

Into each of three sterile petri dishes aseptically pipette a 1 mL portion of the test suspension. To each dish add 15 mL. of freshly melted plate count agar (C-2.3) that has been cooled to 45°C, and mix well. Incubate, count arid calculate the total count as described in BDS ISO 4833.

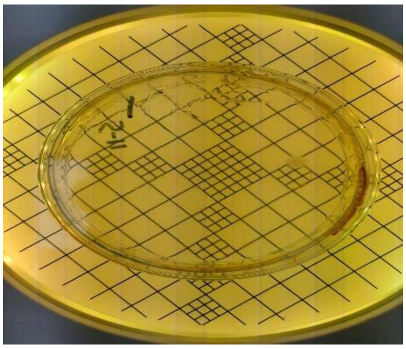
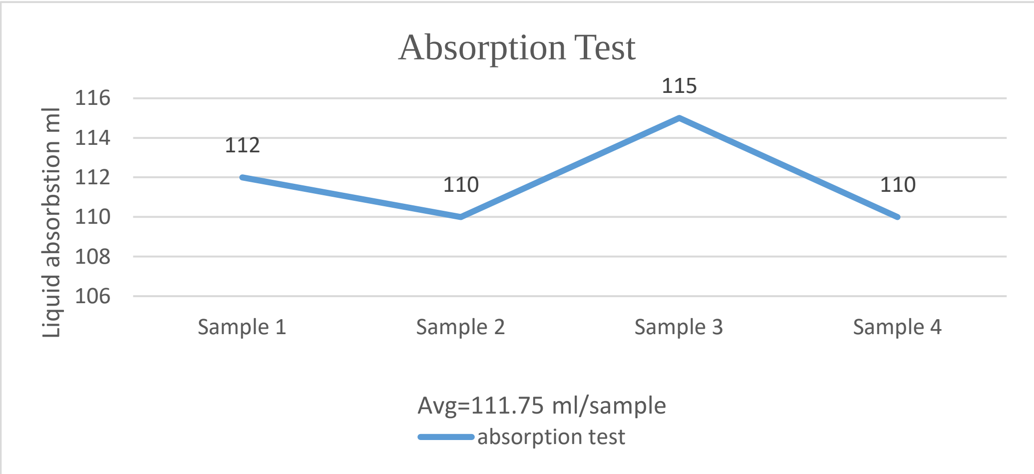


Figure 4-5: Elements of antimicrobial test

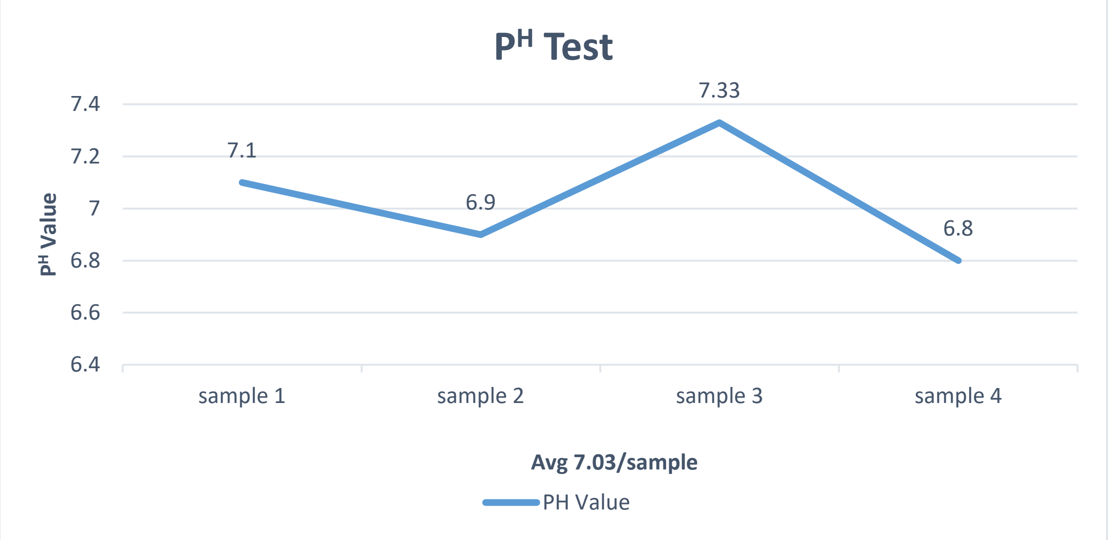
4.2 Result Analysis

The available pads in the market showed absorption capacity of 95-105 mL. The value varies from manufacturer to manufacturer. On the other hand, the pads made from recycled cotton showed an absorption capacity of 111.75 mL avg. According to the Ministry of Health, Labour and Welfare (MHLW), Japan, the standard value for a sanitary pad is no less than ten times the mass of the product (Ministry of health, labour, and welfare 2015). The mass of the absorbent layer of our pad is 10g. The absorption value is in the standard limit without using super absorbent polymers.

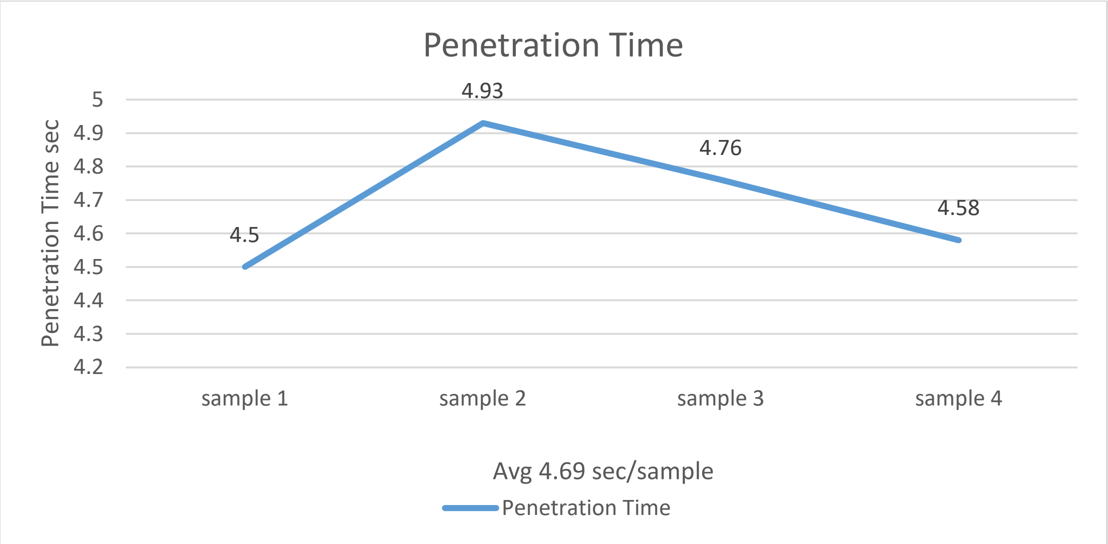


The ability to withstand pressure after absorptions very significant because it defines the quality of the pads. The pads will be subjected to force during regular use. The resulting values for both pads from recycled cotton and pads available in the market are slightly different. It measured the leakage during use by visual observation. In our pad side leakage occurred where the standard pad didn't have any leakage.

P^H test is essential to determine the acidic or basic properties of the sample. In a standard sample it ranges from 5.5 to 8.5. After P^H test the samples showed the P^H value 7.03 in average.



Penetration time resembles the time required to penetrate the sample by the liquid which determines wicking ability of the pads. The penetration time of sanitary pads available in market is 2.5 to 3 sec where the recycled cotton sanitary pads took 4.69 sec to penetrate.



Antimicrobial test: Antimicrobial test is very important for sanitary napkin as it is one of the most important factor in terms of hygiene. It indicates whether the product is hygienic or unhygienic for the body.

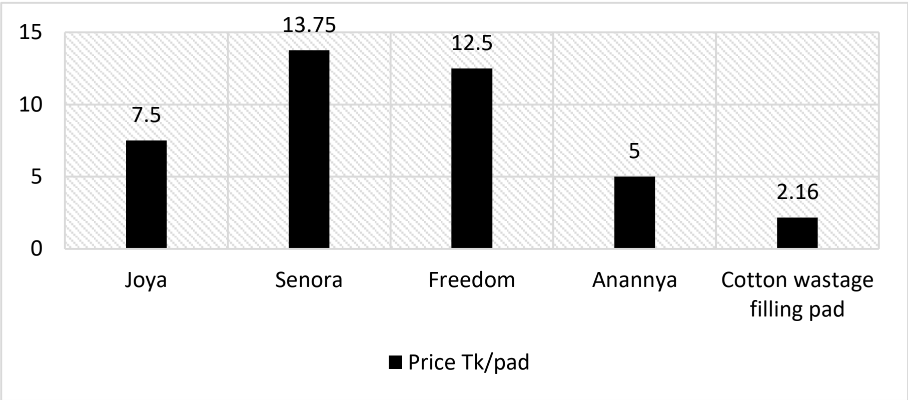
In recycled cotton napkin, the result showed that total viable bacterial count is 22 cfu/ml/g in avg. Which was within acceptable range. According to standard procedure, the range of total viable bacterial count is less than 1000 cfu/ml.

4.3 Cost Analysis

Table 4-1: Cost of producing sanitary pad from recycled cotton

Materials & Factory Overhead	Price	Cost of making on pad
Textile Cotton Wastage	BDT 46/kg	BDT 0.46
PE sheet (bottom layer)	USD 2.96/kg BDT 250/kg	USD 0.0041 BDT 0.35
Non-woven (top layer)	USD 3.13/kg BDT 265/kg	USD 0.0044 BDT 0.37
Factory Overhead		BDT 1
		Total = 2.16 BDT

Cost comparison of different pads:



Market Contribution and Growth of Different Sanitary Napkins:

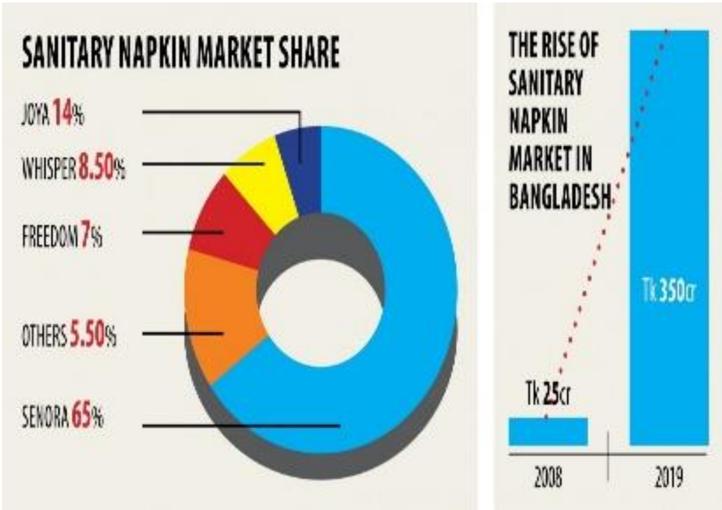


Figure 4-6: Sanitary Napkin Market Share & Growth

Chapter 5 Conclusions

According to the research, production of sanitary pads from recycled cotton is quite possible. 351,000 tons textile waste is produced annually by different factories. Each factory always tries to make the proper utilization of their resources, but it is obvious that a fixed amount of waste will be produced in different section during production. 75% of the resources can be properly utilized and rest of the resources are forbidden as waste. This waste pollutes the environment as most of the waste is disposed into the environment. This research focuses on the proper utilization of textile waste to produce hygiene product for the people of low-socio economic group.

It is believable that if the pads can be made by varying different parameters and raw materials, it can be quite effective. Human feedback is also a major concern for the production of this cotton based pads and to make it affordable. If the feedback given by people is affirmative, then it will be the high time to go for commercial assembly of sanitary pads.

The major limitations of sanitary pads are the top and bottom layer are made of non-biodegradable material. It requires more attention because non-biodegradable materials are not good for the environment. At the end of the day the sanitary pads will be thrown away into the environment. If non-biodegradable materials can be replaced with biodegradable materials, it will be a huge impactful for the sustainability of environment.

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