

Designing of Non disposable baby diapers using Cotton and Bamboo cotton woven fabrics

By
Sindhu, M
(13PTF014)

A Thesis submitted to the
Avinashilingam Institute for Home Science and Higher Education for Women
Coimbatore - 641 043

In Partial Fulfillment of the Requirements for the
Degree of Master of Science
in
Textiles and Fashion Apparel

March, 2015

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Certified as Bonafide Research Work

Nmai
27/3/15
Signature of the
Head of the Department

Rakna
Signature of the
Guide

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CONTENTS

CHAPTER	TITLE	PAGE NO
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF APPENDICES	
1	INTRODUCTION	1
2	REVIEW OF LITERATURE	4
	2.1 Cotton	5
	2.1.1 History	5
	2.1.2 Manufacturing process	
	2.1.3 Properties	
	2.1.4 End uses	
	2.2 Bamboo	8
	2.2.1 History	9
	2.2.2 Manufacturing Process	9
	2.2.3 Properties	11
	2.2.4 End uses	11
	2.3 Blend	12
	2.3.1 Methods of blending	12
	2.3.2 Advantages of blending	12
	2.4 Weaving	12
	2.4.1 Classification of Weaving	13
	2.4.2 Plain Weave	13
	2.4.2.1 Characteristics of Plain weave	14
	2.4.3 Advantages of Weaving	14
	2.4.4 Disadvantages of Weaving	14
	2.5 Diaper	15
	2.5.1 Types of diaper	15
	2.5.1.1 Disposable diaper	15

	2.5.1.2 Non Disposable (cloth) diaper	16
	2.5.2 Functions of diaper	16
	2.5.3 Advantages of Diaper	17
3	EXPERIMENTAL PROCEDURE	
	3.1 Survey	
	3.1.1 Selection of sample	21
	3.1.2 Selection of sample	21
	3.1.3 Conduct of survey	21
	3.1.4 Analysis of data	21
	3.2 Selection of fabric	
	3.2.1 Cotton	22
	3.2.2 Bamboo	22
	3.3 Preparation of fabric	22
	3.4 Selection of diaper	23
	3.5 Development of diaper	23
	3.5.1 Preparation of Manual sketching	24
	3.5.2 selection of sketches	25
	3.5.3 Drafting of diaper pattern	25
	3.5.4 Layout, design and cutting of Material	25
	3.5.5 Construction of diaper	26
	3.6 Nomenclature	27
	3.7 Evaluation	
	3.7.1 Subjective evaluation	27
	3.7.1.1 Visual inspection	28
	3.7.1.2 wear study	28
	3.7.2 Objective evaluation	
	3.7.2.1 Physical Property Test	
	3.7.2.1.1 Fabric weight	28
	3.7.2.1.2 Fabric thickness	28
	3.7.2.2 Mechanical Property Tests	
	3.7.2.2.1. Tensile Strength and elongation	29
	3.7.2.2.2 Abrasion resistance	29

	3.7.2.2.3 Pilling	30
	3.7.2.3 Comfortable Property Tests	
	3.7.2.3.1 Fabric Stiffness	30
	3.7.2.3.2 Crease recovery	31
	3.7.2.3.3 Fabric Drape	31
	3.7.2.3.4 Air permeability	32
	3.7.2.4 Absorbency Tests	
	3.7.2.4.1 Drop Test	32
	3.7.2.4.2 Sinking	32
	3.7.2.4.3 Wicking Test	33
	3.8 Statistical analysis	33
	3.9 Cost Estimation	33
4	RESULTS AND DISCUSSION	
	4.1 opinion of Mothers	
	4.1.1 Preference of diaper	39
	4.1.2 Types of diaper preferred	40
	4.1.3 Preference for Non disposable (Cloth) diaper	41
	4.1.4 Preference for disposable	42
	4.1.5 Fabric Preference for Non disposable (cloth) diapers	43
	4.1.6 Preferences of diaper style	44
	4.2 Consolidation of Manual Sketching	45
	4.3 Subjective Evaluation	
	4.3.1 Visual Inspection	46
	4.3.2 Wear study	46
	4.4 Objective Evaluation	
	4.4.1 Physical Property Test	
	4.4.1.1 Fabric Weight	48
	4.4.1.2 Fabric Thickness	49
	4.4.2 Mechanical Property Test	
	4.4.2.1 Tensile Strength in warp direction	50
	4.4.2.2 tensile strength in weft direction	52
	4.4.2.3 Elongation Warp direction	53

	4.4.2.4 Elongation weft direction	54
	4.4.2.5 Abrasion resistant	55
	4.4.2.6 Pilling	56
	4.4.3 Comfortable Property Tests	
	4.4.3.1 Fabric Stiffness warp direction	56
	4.4.3.2 Fabric stiffness weft direction	57
	4.4.3.2 Crease recovery warp direction	59
	4.4.3.3 Crease recovery in weft direction	60
	4.4.3.4 Fabric Drape	61
	4.4.3.5 Air permeability	62
	4.4.4. Absorbency Test	
	4.4.4.1 Drop Test	63
	4.4.4.2 Sinking	64
	4.4.4.3 Wicking	65
	4.5 Cost estimation	67
5	SUMMARY AND CONCLUSION	68
	BIBLIOGRAPHY	72
	APPENDIX	78

LIST OF TABLES

TABLE NO	TITLE	PAGE NO
I.	Nomenclature	27
II.	Preference of diaper	40
III.	Types of diaper Preferred	41
IV.	Preference of Cloth diapers	42
V.	Preference for Non disposable (cloth)diaper	43
VI.	Preference for disposable diapers	44
VII.	Fabric preference for cloth diapers	45
VIII.	Preference of diaper style	48
IX.	Consolidation of Manual sketching	46
X.	Visual Inspection	47
XI.	Wear Study	48
XII.	Fabric Weight	49
XIII.	Fabric Thickness	50
XIV.	Tensile Strength in Warp Direction	52
XV.	Tensile Strength in Weft Direction	53
XVI.	Elongation of warp Direction	54
XVII.	Elongation of Weft Direction	55
XVIII.	Abrasion resistance	56
XIX.	Pilling	57
XX.	Stiffness in Warp Direction	57
XXI.	Stiffness in Weft Direction	58
XXII.	Fabric Drape	59
XXIII.	Air permeability	61
XXIV.	Drop Test	62
XXV.	Sinking	65
XXVI.	Wicking	66
XXVII.	Cost estimation	68

LIST OF FIGURES

FIGURE NO	TITLE	PAGENO
1	Manufacturing Process of Cotton	6
2	Manufacturing Process of Bamboo	9
3	Classification of Weaves	13
4	Types of Diapers	15
5	Methodology	20
6	Preference of diaper	40
7	Types of diaper preferred	41
8	Preference of Cloth Diapers	42
9	Preference for Disposable	43
10	Fabric Preference for diaper	44
11	Preference of diaper style	45
12	Wear study	48
13	Fabric Weight	49
14	Fabric Thickness	50
15	Tensile Strength in warp Direction	52
16	Tensile Strength in Warp Direction	53
17	Elongation of Warp Direction	54
18	Elongation of Weft Direction	55
19	Abrasion Resistance	56
20	Pilling	57
21	Stiffness in Warp Direction	57
22	Stiffness in Weft Direction	58
23	Crease recovery warp direction	59
24	Crease recovery Weft directions	61
25	Fabric Drape	62
26	Air permeability	63
27	Drop Test	64
28	Sinking	65
29	Wicking	66

LIST OF PLATES

PLATE NO	TITLE	PAGE NO
I	Manual Sketching	34-35
II	Selection of Design	36
III	Visual Inspection	37
IV	D2 pull on diaper	37
V	D3 All in one diaper	37
VI	D8 Fitted diaper	37

LIST OF APPENDICES

APPENDIXNO	TITLE	PAGE NO
I	Questionnaire to elicit information regarding mothers preference baby on diaper	78
II	Visual Inspection	80
III	Wear study	81
iv	Details of the fabric samples	82

I. INTRODUCTION

Clothes are made up of fabric selected mainly for their preference and properties. Clothes are worn by people for various reasons. The use of the clothing is protection, modesty and self adornment (geetha and Jacob 2005). Clothing is important interface between the human and environment clothing helps you to maintain your property body temperature. Comfort is related to personal sensitivity and is a highly individual matter. It involves direct contact of the fabric when used for such purposes as temperature control, concealment or adornment.

The effect of clothing can take care of psychological and physical aspect of comfort kholiya and geol. (2008). clothing is the second skin ranking with food and shelter as essential for human survival. Clothes are an onward expression of how people feel about themselves and the kind of world they tend to live in pati, (naik and gandhad, 2001).

Clothing plays an important role in developing overall personality of the child, a thoughtful planning and selection of clothing for the young children. Human considered necessary. Since mothers are primarily responsible for their children, they are accepted of children's clothing (Prasad and mazumdar, 2007)

Babies need layer of clothing that can be removed or added easily. These layer clothes to regulate their body temperature. Clothing also needs to be easily washed and easy to remove for nappy changing. (Tassoni, 2007) Baby clothes made out of material that is soft, pliable, and absorbent. The materials are durable, easily laundered. The clothing should be light weight and sufficient to keep the body at the normal temperature of 98.6°.

The garment is constructed to allow the ventilation. The clothing is constructed with smooth flat seams and simple fastenings. The garment should be comfortable and allow freedom of movement.(Thompson, and Rea et al ,2000) suggests suitable fiber for baby clothing are organic cotton, wool, coir, Bamboo fiber, Viscose fiber, Chitcel fiber. The weaves in baby clothing can be sateen, satin used for summer wear, Twill and Plain weave also used for baby Clothing. Baby clothing must have flame retardant and UV protective material. The clothing should

essentially follow Oeko-Tex standards to decide the residue content of formaldehyde, heavy metals and other chemicals. (Bhargava and Singh 2006).

Diaper is a kind of underwear that allows one to defecate or urinate in a discreet manner. Diapers are made of cloth or synthetic disposable materials. (Morrison, 2009) Disposable diapers are commonly used and these diapers are highly absorbent and convenient. Disposable keep the baby skin dries. Disposable diapers generally are not considered biodegradable. These diaper contain super absorbent material (gel form) the gel they often contain bad for environment. (Mueser 2013). These diapers are expensive. Since they are super absorbent many parents change diapers only after long period of time. Extreme saturation of the diapers can give rise to diaper rash. Chemicals used in the manufacture of high absorbent disposable diaper sodium poly acrylate were used that contain toxic (shock syndrome) and can lead to sensitivity. (Lillard and Jessen 2003)

Cloth diaper is reusable and can be made from natural fibers, manmade materials, or a combination of both. Bauer (2006). They are often made from industrial cotton which bleached or left in the natural color. Cloth diapers are usually composed of layer of fabrics such as cotton, hemp, bamboo, or microfibers and washed and reused. Traditionally cloth diapers consisted of folded square or rectangle of cloth. Modern cloth diapers come in host of shapes Leverich (2010). Cloth diapers are environment friendly dumping virtually nothing at landfills and not contributing to pollution. It is guaranteed to glide smoothly on baby skin. Cotton and other natural fibers breathe easier. (Kumar 2012).

Eco-friendly means ecologically friendly; and will not damage any part of the ecosystem. Eco-friendly items are biodegradable and do not contain hazardous chemicals. Kocsis (2010). Eco –friendly fabrics are gaining popularity and used in clothing. Eco friendly fabric may be a natural fiber such as cotton, hemp or bamboo which has been grown in soil that has not been treated with pesticides for a number of years. Some examples of other eco-friendly fabrics are organic cotton, sisal, a combination of hemp and recycled rayon. Acton (2013)

Cotton is the true “miracle fiber”. Cotton is oldest natural fiber. Cotton is a natural lignocelluloses fiber that contains 85% cellulose and low lignin, compare to other natural fibers cotton only having higher lignin cellulosic fibers. Cotton fabrics

have a cultural value. Cotton fabrics combine durability with wearing quality and comfortable. The wet cotton fabric is stronger than dry cotton. Cotton can withstand repeated washing. Bowers (2011) Cotton is used to produce apparel, home furnishing, and industrial products. Wakelyn and Bertoniero et al (2006).cotton fibers are used for towels, surgical drapes, and disposable to biodegradable products. Cotton is non allergenic natural fiber that does not irritate skin. Cotton strength and absorbency makes a fabric for medical and personal hygiene products.(Mussig 2010).

Bamboo fiber is a regenerated cellulosic fiber. It is a 100% biodegradable fiber. Bamboo clothes are better moisture absorption. Bamboo fabric is exceptionally soft, and light, almost silky in feel. This makes it breathable and cool to wear. It is 60% more hygroscopic than cotton. Bamboo fabric often blended with 30% cotton to add structure to the garment.(Yueping and Xushan 2005) Bamboo fibers are used as bathrobes, foot mats, bamboo socks, and blanket. The ultraviolet nature is sustainable to make summer cloth especially for the pregnant ladies and children's from ultraviolet radiation. It is also used as sanitary materials. Bamboo fabric were used for range of baby clothing such as caps, baby socks, t-shirts, rompers, and baby bedding cloth and children pillow cover (Jones 2014).

Considering the above facts, the investigator decided to study on **“Designing of Non disposable baby diapers using cotton and bamboo cotton woven fabrics”** with the following Objectives.

- To study and select eco-friendly fabrics suitable for baby diapers
- To construct baby diapers using the selected fabrics
- To compare and evaluate the baby diapers

II. REVIEW OF LITERATURE

The Review of literature pertaining to the title “**DESIGNING OF NON DISPOSABLE BABY DIAPERS USING COTTON AND BAMBOO COTTON WOVEN FABRICS**” Is listed under the following headings.

2.1 Cotton

2.1.1 History

2.1.2 Manufacturing process

2.1.3 Properties

2.1.4 End uses

2.2 Bamboo

2.2.1 History

2.2.2 Manufacturing process

2.2.3 Properties

2.2.4 End uses

2.3 Blend

2.3.1 Introduction

2.3.2 Development of blended fabrics

2.3.3 Blending for several reasons

2.4 weaving

2.4.1 Classification

2.4.2 Plain weave

2.4.2.1 Characteristics of Plain weave

2.4.3 Advantages of weaving

2.4.4 Disadvantages of weaving

2.5 diaper

2.5.1 Types

2.5.2 Functions of Diaper

2.5.3 Advantages

2.1 COTTON

The cotton fiber grows in the seed pod or boll, of the cotton plant, Each fiber is a single elongated cell that is flat, twisted, and ribbon like with a wide inner hallow (lumen).it is composed of a about 90% cellulose and a about 6% Moisture the remaining consists of natural impurities Singh (2004) the outer surface of the fiber is covered with a protective wax like coating, giving an adhesive like quality Kalia, Kaith et al (2011)

Cotton is most common textile fiber in use. Cotton is called as “**king of cotton**” and also called “**white gold**” of India. India ranks second in cotton production. It is eco-friendly fiber. Fine cotton is used for baby clothes. Cotton fabrics are used universally for apparel and home textile products. The fiber is also used for industrial applications including medical, surgical, and sanitary applications Sekhari. (2011)

2.1.1 History of cotton

Cotton belongs to the family **Malvaceae** and genus **Gossypium**. The world's cotton belt is located mainly in the tropics and sub-tropics warm and humid climates. It grows in almost hundred countries of the world with a soil and climate bringing about variations. Probably it originated In India mentioned in “**Rig Veda**” written nearly 3,500 years ago. Cotton was first cultivated more than 6000 years ago, In Harappa cultural region of Southeast Asia. Its use spread from there and farmers around the world adopted the plant for their own specific climate needs. (www.cottonindia.com)

In the Indus river valley in Pakistan, cotton was grown, spun and woven into cloth 3,000 years BC. At about the same time, natives of Egypt's Nile valley were

making and wearing cotton clothing .Arab merchants brought cotton cloth to Europe about 800A.D. Columbus found cotton growing in the Bahamas Islands. By 1500, cotton was known generally throughout the world. Thomas (2006)

2.1.2 Manufacturing process of Cotton

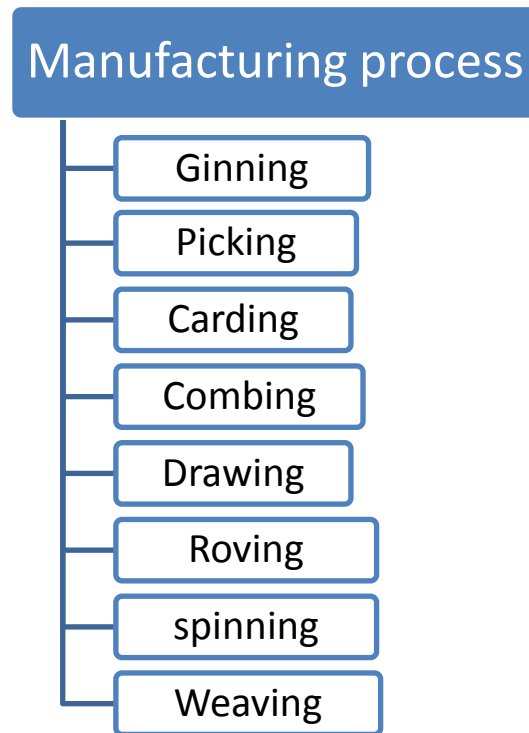


Figure-1

- **Ginning**

First picked cotton is called seed cotton. Seed cotton has been fed in to the Gin, which comprises a series of circular saws which project through steel ribs. The saw separate the lint or fiber from seeds. It is then carried to the bailing press. There they compressed and packaged into the standard bail of 500 lbs.The first ginning does not remove all the fiber from seeds, they are put through a second ginning process which removes the short fibers called linters. Rastogi (2009)

- **Picking**

Picking is the process to remove foreign matter (dirt, insects, leaves, seeds) from the fiber. Early pickers beat the fibers to loosen them and remove debris by hand. Machines used rotating teeth to do the picking and producing a thin “lap” for carding. Jefferson (2009)

- **Carding**

Carding machine straightens the mass of fibers and lays them in parallel rows by drawing them over a revolving cylinder with teeth. The fibers emerge as wide thin web which is then collected together into rope or strand called a sliver. Tanya (2012)

- **Combing**

Some fabrics are made from carded yarns but if higher quality is desired, the fiber goes from carded to the combing machine. The fiber is combed by machine until all short linters are eliminated. It is then formed into combed slivers. Premlatha (2006)

- **Drawing**

Slivers or loose fiber-ropes coming out from the carding machine are fed into the drawing frame, clubbing four to eight slivers side by side. As they passed between the rollers of increasing speed, they had drawn out into a single sliver.

- **Roving**

Roving frames reduces to finer thread, gives more twist, makes more regular and even in thickness, and wind on to a smaller tube. Premamoy (2004)

- **Spinning**

The spinning frame takes the roving and continues the process of drawing out and twisting until the finished yarn emerges and is wound on the bobbins. Warp yarn generally need more twisting than filling .Neelima (2009)

- **Weaving**

Weaving is the oldest form of fabric construction. Weaving is major method of fabric construction method because it is basically simple and adaptable .Kapoor (2012). Were two sets of yarns are interlaced with one another right angle. Many different interlacing patterns give interest to fabric. Fabric can be reveled from adjacent sides fabrics have grains. Vidyasagar (2005)

2.1.3. Properties

- Absorbent cotton will retain 24-27 times its own weight in water and is stronger when wet than dry.
- Fiber absorbs and release perspiration quickly, thus allowing the fabric to 'breathe' Humphries(2012)
- Cotton can stand high temperatures and takes dyes easily.
- Cotton is a non-allergenic natural fiber that does not irritate the sensitive skin(www.TextileLearners.com)
- Cottons softness makes it a preferred fabric for under garments and other skin close garments Mendelson(2009)
- Cotton keeps the body cool in summer and warm in winter because it is a good conductor of heat.gleason(2006)
- Cotton's strength and absorbency make it an ideal fabric for medical and personal hygiene products such as bandages and swabs.
- Cotton becomes stronger when wet. (www.cottonindia.com).

2.1.4. Uses of cotton

Cotton is used to make a number of textile products. These include terry cloth, used to make highly absorbent bath towels and robes; denim used to make blue jeans'-shirts, bed sheets, socks, underwear. In addition to textile industry, cotton is in fishnets, coffee filters, tents gun powder (nitro cellulose), cotton paper, and in book binding .Rastogi (2009) The Finer Cotton yarns are used for high grade clothing and home Textile feng and xu et al.(2013)

Cotton fabrics made into home decorative linens, including curtains, table clothes bed sheets and terry cloths, towels, carpets, rugs, automotive upholstery made out of woven fabrics. Cotton is used in Medical applications surgical sponge, sanitary applications, cosmetics, babies nappies. Singh (2010)

2.2 BAMBOO

Bamboo is a natural, eco-friendly fiber, it is regenerated cellulosic fiber produced from pulp of bamboo stem. Rathod and Kolhakar (2014) .Among many eco-products, bamboo are the fastest growing tree on earth. A renewable resource

bamboo used in the production of eco-textile. Bamboo yarn manufacturing is done in environmental friendly way. It is green environmental protection raw material for production of apparel. Krishnan and Karthi (2014).

2.2.1 History of bamboo

Bamboos are called as the “**friend of people**” in china, “**the wood of poor**” in India, and “**brother**” in Vietnam Marilyn (2009).Bamboo is a group of perennial ever green in the true grass family Poaceae, sub family Bambusoideae, tribe Bambuseae, more than 1,450 bamboo species from 70 genera are found in diverse climate-from cold mountains to hot tropical regions. Gratani and Crescent et al (2008) it is consist of cellulosic fibers embedded in lignin matrix. Two types of cells exist in bamboo matrix tissue cells and sclerenchyma cells act as reinforcement in bamboo. Chand and Fahim (2008)

China is known as “**kingdom of bamboo** “due to the fact that there are more than 400 species of bamboo growing under her sovereignty. Bamboo is found in diverse climates from cold mountains to hot tropical regions. Jiang (2010)

2.2.2 Manufacturing process of Bamboo

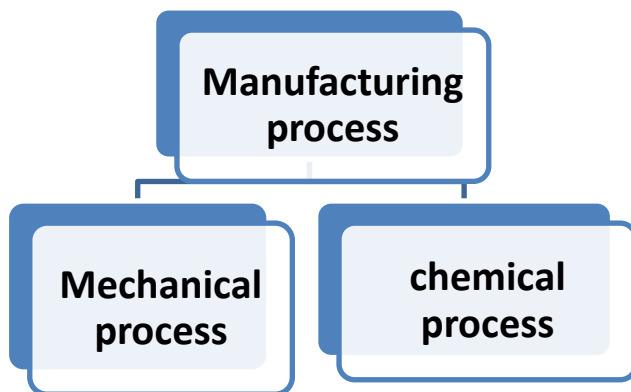


Figure-2

2.2.2.1 Mechanical process

There are two ways to process bamboo to make the plant into a fabric, mechanically, or chemically. Mechanical way is by crushing the woody parts of the bamboo plant and then uses natural enzymes to break the bamboo walls into a

massy mass so that the natural fiber can be mechanically combed out and spun into yarn. Liu and song et al. (2012)

2.2.2.2Chemical process

Bamboo leaves and the soft inner pith from the hard bamboo trunk are extracted and crushed. The crushed bamboo cellulose soaked in a solution of 15-20 % sodium hydroxide at a temperature between 20-25°C, for one or three hours to form a alkali cellulose. The alkali cellulose is then pressed to remove any excess sodium hydroxide solution. The alkali cellulose is then crushed by a grinder and left to dry for 24 hours. Roughly a third much as carbon disulfide is added to the bamboo alkali cellulose to sulfurous the compound causing it to jell. Liu and Wang et al. (2011)

Remaining carbon disulfide is removed by evaporated due to decompression and cellulose sodium xanthogenate results. A dilute solution of sodium hydroxide is added to the cellulose xanthogenate dissolving it to create a viscose solution consisting of about 5% sodium hydroxide and 7-15% of bamboo fiber solution. The viscose bamboo cellulose is forced through spinneret nozzles into a large container of a dilute sulfuric acid solution which hardens the bamboo cellulose .Sodium xanthogenate and reconverts it to cellulose bamboo fiber which is spun into re constructed and regenerated bamboo fabric. Sinha (2011)

2.2.3 Properties of bamboo

- The bamboo fabric is very soft than cotton.
- It has a good moisture absorption and ventilation.
- It breathes easier and cooler than cotton in warm weather. Shankar and Krishnan (2012)
- Bamboo is highly water absorbent and able to take up three times its weight in water.
- Hundred percent bamboo fibers have good elasticity nearly 20%.
- Bamboo fabric is apparently able to retain, even through multiple washes.
- Bamboo fabrics avoid pilling and shrinkage problems. Devi, Poornima. etal (2007)

- Bamboo also has many anti-bacterial qualities, Anti-bacteria, anti-bacterio static and deodorization even after 50 times of washing the bamboo fabric.
- Bamboo Can absorb and evaporate sweat in split of seconds just like breathing which keeps wearer, extremely cool, comfortable and none sticking to skin in hot summer. sinha and Malik (2011)
- Naturally wrinkle resistant ironing is not required.
- In general bamboo fiber clothing can be machine washed in cool water with mild soap on gentle cycle.
- Bamboo fabric do not require softeners, it is naturally soft.
- Bamboo is blended with other fibers Cotton, Lycra, Spandex, and Polyester. (www.fiber2fashion.com).

2.2.4 End uses of bamboo fiber

Bamboo fabrics have different end uses of clothing -shirts, dresses, shorts, and slacks because of their antimicrobial properties. They are used for Sports socks, dress, towel, seamless inner wear, t-shirts, dress shirt, work wear, defense uniform. Bamboo fabric is used for baby clothing, under garments, sweaters, towel, baby nappies (diapers). It also used for house hold furnishing, bed sheets, pillow cases and drapery materials. Mahesh and Anitha (2014).

2.3 BLEND

Blending is the process of combining two or more fibers to get all their desirable properties and minimize the blend cost. The blending of different quality fibers of the Same type well established technique for achieving quality and economic .it gives a aesthetic and functional properties of the end product Paul and Newman(2011)For example, cotton is often blended with polyester ethylene terephthalate (PET) fibers to enhance durability and make the fabric easy to care Burns (2007)

Blending process done at weaving or knitting levels. Blending cotton with other fibers include wrinkle resistance, elasticity, luster drape, Townsend (2005) Blending has two purposes: to produce a through intermixing of fibers and to mix together fibers with different characteristics to produce yarn qualities that cannot be obtained by using one type of fiber alone. Goswami, Martindale. Et al (2011)

.Blending is done to improve absorbency, dimensional stability, and increase strength and facilitate processing Kaplan (2002).

2.3.1 Methods of blending

Blending can be done at the opening stage, drawing

- In the initial opening stage of the blow room operation, the fibers are spread one on top of the other and fed into the blending feeder.
- The blending can also be done in the carding stage.
- Similarly the blending can be done at drawing or roving stage.
- A filament yarn blended contains yarns of different deniers (denier is the yarn numbering system used for filament yarns) blended together.(www.textilesindepth-textilefiber.blogspot.in)

2.3.2 Advantages of blending

- To create a textile with positive qualities of two or more different fibers
- To produce a variety in yarn, sheen, or appearance Nielson(2008)
- To produce fabrics with a better combination of performance characteristics
- To improve spinning, weaving, and finishing efficiency and to improve uniformity
- To obtain better texture, hand, or fabric appearance. Fibers with different shrinkage properties are blended to produce bulky, lofty fabrics or more realistic fur like fabrics.
- To minimize fiber cost. Expensive fibers can be extended by blending them with less-expensive fibers. Kadolph (2009)

2.4 weaving

Weaving is a method of fabric construction in which two or more sets of yarns are interlaced at right angle. The manners in which the sets of yarns are interlaced determined to a great extent the characteristic of the cloth.

Designs that are woven in the cloth are plotted on design paper. This squared paper is arranged so that the vertical, or up-and-down, rows of squares represent the

warp. The horizontal rows represent the filling. This is merely for convenience in counting the squares; it has no influence on the design. Vidhyasagar (2008)

2.4.1. Classification of weaves

Weaves can be classified into basic and fancy or decorative weaves.

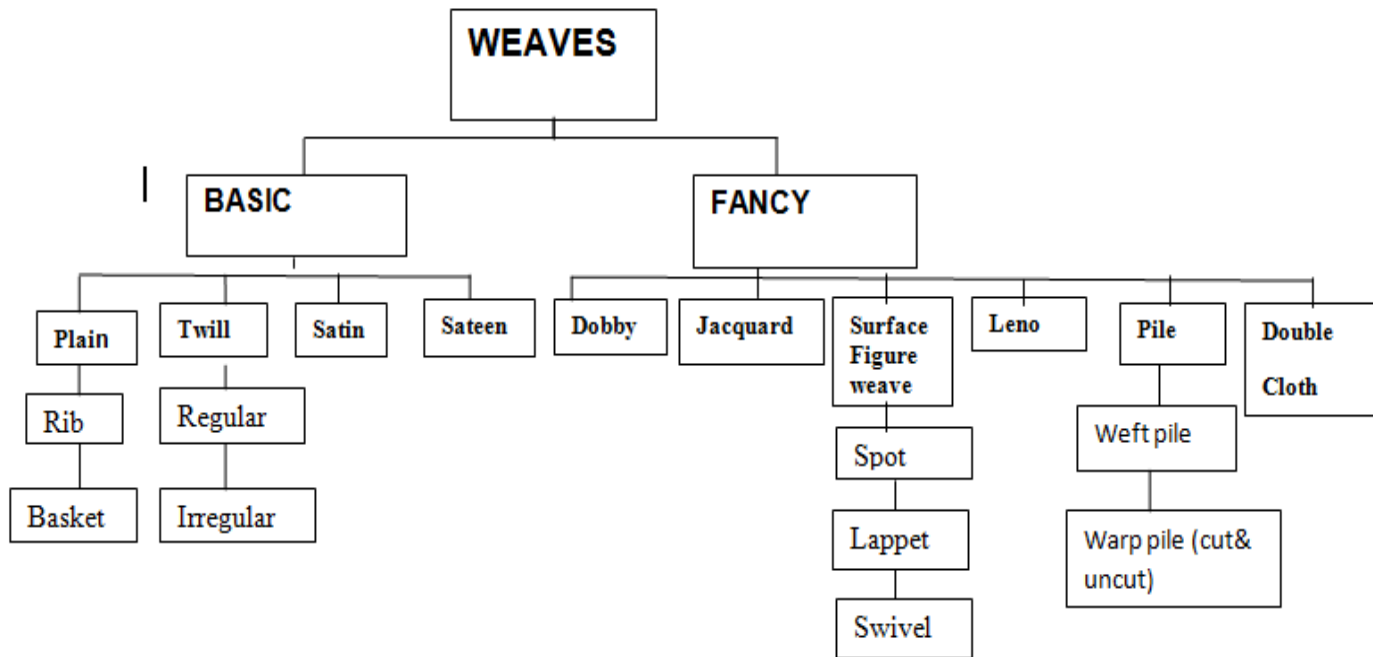


Figure-3

2.4.2 Plain weave

Plain weave is the simplest of all weaves. It has one –over one-under interlacing for both warp and filling yarns. The plain weave formula repeats on two warps and two filling yarns and the same texture on both top and bottom sides. Plain weave requires two harnesses. It can be woven more than two harnesses especially if the warp density is more than 50 per inch; it is woven on four harnesses. Sabit (2009) the maximum number of intersections of warp and weft yarns makes a plain weave fabric the strongest and stiffest among the various woven structures. About 40% of all fabrics produced are in plain weave. Examples of plain weave fabrics are organdie, muslin, cambric, poplin, flannel, mulmul, shantung, and canvas. Plain weaves are widely used in various industrial fabrics example tents/shelters, protective clothing, parachutes, and specialized clothing. Sen (2001)

2.4.2.1 Characteristics of plain weave

- It has maximum number of binding points.
- The threads interlace on alternate order of 1 up and 1 down.
- Threads density is limited.
- Cloth thickness and mass per unit area are limited.
- It produces a relatively stronger fabric that is obtained by any other simple combination of threads, excepting that of “gauze” or “Weaving”. Neshan(2009)
- Plain weave can be strong and durable depending on the way the yarns are laced together.
- The fabric has no right or wrong side, unless it is printed or specially finished
- Sometimes the yarns are varied in type, colour and size to add interest to the weave. Caribbean Association(2000)

2.4.3 Advantages of Woven fabric

Woven fabrics are

- Versatile in application
- Excellent drape ability
- Easily dyed and printed
- Dimensionally stable
- Hydrophilic/absorbent
- Low luster
- Good hand, comfortable
- Long lived with proper care and maintenance

2.4.4 Disadvantages of Woven fabrics

- Wrinkle unless blended or treated
- Low abrasion resistance
- Low resilience and abrasion resistance
- Dries slowly Nielson(2008)

2.5 DIAPER

A diaper or nappy is an absorbent garment worn by individuals who are incontinent (lacks control over bladder or bowel movements), unable to reach the toilet when needed. Maria (2008). Baby diapers are used to absorb and retain human fluids of infants in period between birth and 24 months. Diapers essentially made by a sandwich of an absorbent pad between fabric sheets. Diapers prevent fluid leakage and give the desirable shape. The baby diapers are available in four sizes- small, medium, large, extra large. Sathish, kulkarni et.al (2014)

In recent improvements in diapers, have included more stretchable waist bands, improved leg cuffs thinner more absorbent core. Some of the important factors of hygienic products are: Breathability and comfort ,Barrier Properties/ leaking, Wicking and wetting behavior, Disposal and flush ability, Protection /antimicrobial properties, Smartness/enviromental response. Jassal (2011)

2.5.1 Types of diapers

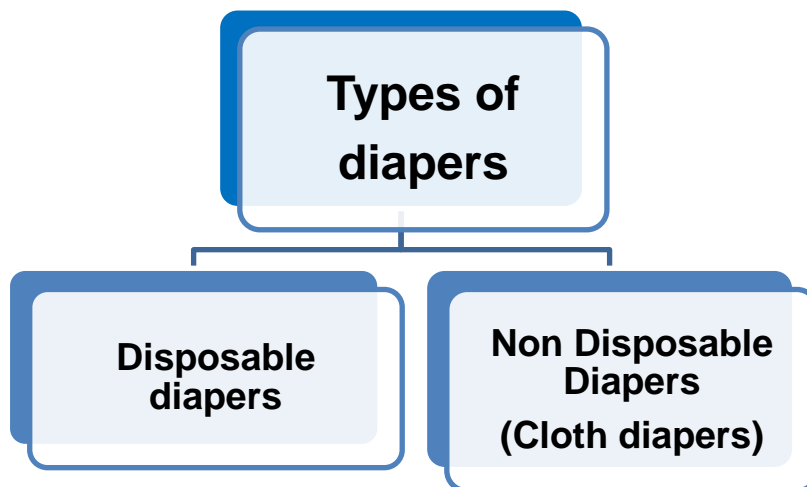


Figure-4

2.5.1.1 Disposable diapers

Disposable baby diapers and incontinence product have a layered construction, which allows the transfer a distribution of urine to an absorbent core structure is locked in. Basic layers are an outer shell breath able polyethylene firms or a nonwoven and film composed which prevents wetness and soil transfer, an

inner absorbent layer of a mixture of air-laid paper and superabsorbent polymers for wetness, and a layer nearest the skin of nonwoven material with a distribution layer directly beneath which transfers wetness to the absorbent layer. These diapers include one or more pairs of adhesive or Velcro tapes to keep the diaper securely fastened. NPCS Board (2014)

2.5.1.2 Non Disposable (Cloth Diaper)

Non disposable diapers come in several different types of cloth and shapes. Cloth diapers typically have two parts. There is an inner layer, which is usually made from a soft cotton material, and outer cover made from a type of plastic, cotton or terry cloth. Cloth diapers are usually fastened with snaps or fabric fasteners, not pins. Mayo clinic (2012)

Cloth Diapers moisture evaporate and air circulate freely and allowing baby body to cool when heat builds. Kelly (2011) a cloth diaper provides a gentle touch to the infant's skin than the disposable diapers. Zhong (2013) the natural fabric of cloth diapers are more comfortable for babies with skin allergies or sensitive's, and reduce occurrence of diaper rash in babies. Fierro (2012)

2.5.2 Function of Diaper

The function of a baby diaper are

- keep the surface layer as dry as possible in order to facilitate good skin care conditions.
- transfer liquids from the surface through to an effective storage layer.
- Absorb and store transmitted liquids in such a way that they will not be released back through the structure to the surface.
- Provide an efficient containment system to contain the absorbent layers in order to protect the user environment
- Be capable of appropriate and environmentally compatible disposal after use. Das and Pourdeyhimi (2014).

2.5.3 Advantages of Non disposable diaper (cloth diaper)

- Non disposable diapers are less expensive.
- These diapers cool and comfortable.(www.theclothdiaperwhisperer.com)
- These diapers are made from natural materials and do not contain harsh chemicals.
- This diapers used to reduce Diaper rash.(www.baby.more4kids.info)
- These diapers do not contain fragrances which are common among disposable diapers. This fragrances cause headaches, dizziness, and skin irritation.
- Cloth diapers let moisture evaporate and air circulates freely allowing baby freely allowing baby body to cool when heat builds. Kelly (2011).
- Natural fabrics of cloth may comfortable for babies with skin allergies and sensitivities.
- Non disposable diapers easy to use and disposable.(www.mothing.com)
- Cloth diapers are composed layer of fabric such as cotton, hemp, bamboo that can be washed and reused multiple times. Gookin and Gookin (2011).
- Non disposable diapers used for environmental reasons .these diapers used to reduce landfills of disposable diapers Weiss (2007).

III. EXPERIMENTAL PROCEDURE

3.1 Survey

3.1.1. Selection of Tool

3.1.2 Selection of sample

3.1.3 Conduct of Survey

3.1.4 Analysis of Data

3.2 Selection of fabric

3.2.1 Cotton

3.2.2 Bamboo

3.3 Preparation of fabric

3.4 selection of Diaper

3.5 Development of Diapers

3.5.1 Selection of Diaper Design

3.5.2 Construction of Diaper

3.5.2.1 Drafting

3.5.2.2 Preparation of fabric for cutting

3.5.2.3 Layout.

3.5.2.4 Cutting and sewing diaper design.

3.6 Nomenclature

3.7 Evaluation

3.7.1 Subjective Evaluation

3.7.1.1 Visual inspection

3.7.1.2 Wear study

3.7.2 Objective Evaluation

3.7.2.1 Physical property test

3.7.2.1.1 Fabric count

3.7.2.1.2 Fabric weight

3.7.2.1.3 Fabric Thickness

3.7.2.2 Mechanical Property tests

3.7.2.2.1 Tensile strength and elongation

3.7.2.2.2 Abrasion resistance

3.7.2.2.3 Pilling

3.7.2.3 Comfortable property tests

3.7.2.3.1 Fabric stiffness

3.7.2.3.2 Crease recovery

3.7.2.3.3 Drape

3.7.2.3.4 Air permeability

3.7.2.4 Absorbency test

3.7.2.4.1 Drop test

3.7.2.4.2 Sinking test

3.7.2.4.3 Wicking test

3.8 Statistical analysis

3.9 Cost Estimation

III. EXPERIMENTAL PROCEDURE

The Methodology adopted for the experiment “**Designing of Non Disposable Baby diapers using cotton and bamboo cotton**” is discussed under the following headings.

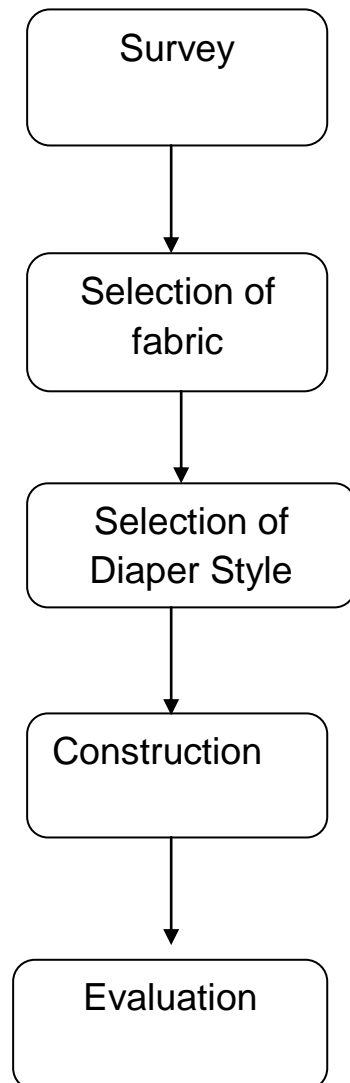


Figure-5

3.1 SURVEY

The steps involved for conducting the survey are as follows:

3.1.1 Selection of Tool

Questionnaire is a device for securing answer to question using a form by which the respondents fill by themselves (Gupta 2009). Questionnaire method was adopted for the collection of data. The questionnaire was formulated in order to elicit information about the preference towards the selection of cloth diapers. This was pretested and modified as required. Thus finalized questionnaire is presented in Appendix-

3.1.2 Selection of sample

Sample is a part of the population which one selects for the purpose of investigation (Dutt, 1998). Samples may achieve much response rate and higher cooperation in general when every element in a population has equal chances to be selected (Gupta, 2005). Sampling is a process of selecting a few (a sample) from a bigger group (the sampling population) to become the basis for estimating or predicting the prevalence of an unknown piece of information, situation or outcome regarding the bigger group. A sample is a subgroup of the population (Kumar, 2005).

The sampling technique involved is convenient sampling. Convenience Sampling is a non-probability sampling technique where subjects are selected because of their convenient accessibility proximity to the researcher. This sample is used because it allows the researcher to obtain basic data and trends regarding his study without the complications of using a randomized sample. This sampling technique is also useful in documenting that a particular quality of a substance or phenomenon occurs within a given sample. Such studies are very useful for detecting relationships among different phenomena (Thejaswini, 2014).

The investigator selected the convenient method of sampling to gather information for the study as careful selection of sample will give good results. Fifty mothers of 0-12 months were selected as subjects for the study.

3.1.3 Conduct of the survey

A good rapport was established with the subjects. Then the information was collected from the respondents with the help of the questionnaire and data was collected.

3.1.4 Analysis of Data

The data after collection has to be processed and analyzed in accordance with the outline laid down for the purpose at the time of developing the research plan. Technically processing implies editing, coding, classifying and tabulating the collected data, so that they are amendable to analysis (Gupta, 2009). The collected data was consolidated, tabulated and statistically analyzed

3.2. SELECTION OF FABRIC

The textile industry uses many different kinds of fibers as its raw materials. This fiber is classified as natural and manmade fibers. Natural fibers are produced from naturally available material.

3.2.1 Cotton

Cotton is natural lignocelluloses fiber that contains 85% cellulose. (Bhatt and Kamath et al,2007). Cotton fabrics has large a Morpheus portion that makes comfortable to use. It has high absorbency and feels soft to use. Cotton fabrics have well drape ability. Cotton is most widely acceptable textile fibers for apparels due to their comfort properties and used for production of surgical gowns and baby clothes. Cotton fibers are used from garments to sheets, towels to surgical drapes and disposable to biodegradable products. (Bunsell 2009)

3.2.2 Bamboo

Bamboo fabric feel silky soft . (Barclay et al 2007).Bamboo fabric is washable and durable. This fabric is thinner than cotton; they are also anti-bacterial and anti-fungal and higher UV protection MacBride (2011). The absorbent properties make the intimate apparel more comfortable as it does not stick to the skin. Bamboo fabric is used for medical suppliers and sanitary materials; It is Hypo allergenic; it keeps allergens away from people. (Schaeffer 2008)

Cotton and bamboo fabrics properties are very much suitable for baby clothing. These fabrics are biodegradable and economical friendly and environmental responsible. Due to the above mentioned properties cotton and bamboo was selected for making baby cloth diaper.

3.3 PREPARATION OF FABRIC

The size is a protective coating applied to the warp yarns. The desizing step is designed to remove the warp size. It is preparatory process carried out before applying any kind of finish to the fabric (Behery, 2005). So, the sized cotton, and bamboo fabrics was subjected to desizing to remove the size matter from the fabric. For desizing, the fabric was immersed in detergent solution prepared using soft water which was boiled for half an hour. Then the fabric was taken out, rinsed thoroughly and dried in shade.

3.4 SELECTION OF DIAPER

Diaper is a piece of cloth or absorbent material folded and worn as under pants. Cloth diapers are made from natural fibers such as cotton hemp and bamboo. This diaper does not contribute landfills. (Komaroff 2005) .cloth diapers are used several times such as 200times.cloth diapers are biodegradable (Klopffer and Grahl 2014) cloth diapers are easily washable and can be reused hence economical. A cloth diaper reduces painful rashes. Gupta(2014). The majority of mothers preferred cloth diapers. Hence cloth diaper was selected for the study based on above facts.

3.5 DEVELOPMENT OF DIAPER DESIGN

The designs were developed for the cloth Diaper through manual sketching; From the survey design has been selected based on the mother's preferences.

Fashion illustration is the communication of fashion that originates with illustration, drawing and painting. Fashion illustration has been around for nearly 500 years. Ever since clothes have been in existence and there was need to translate an idea or image into a garment there has been a need for fashion illustration. It shows the presence of hand and is said to be visual luxury (Kumar, 2010).

The diapers were illustrated according to the preference of mothers and given for selection of style.

3.5.1 Preparation of manual sketching

The sketches were prepared for 10 different styles of diapers. The sketching is mentioned below; included in Plate-I

- **Cover or wrap (D1)**

D1 the cover or wrap is designed as a Diaper1.the cover wrap were cut on straight grain and vertical edges of the wedge full in bias. The material with elastic legs and back are finished with Velcro or closures.

- **Pull-on (D2)**

D2 the pull-on is designed as a Diaper2.The pull-on were cut on straight grain and elastic are used legs and waist.

- **All-in one (D3)**

D3 the All in one is designed as Diaper3.All-in one diapers having an absorbent part is removable. This makes the outer and absorbent inner are single piece. Elastic at hip and thighs for grip and back snap or Velcro closures for hold are given.

- **All-in Two (D4)**

D4 the All in Two is designed as Diaper4. All in Two this makes the outer water proof shell reusable. The absorbent part is removable.

- **Pocket (D5)**

D5 the Pocket is designed as Diaper5.the pocket is covered by wicking layer of fabric. Inside the diaper absorbent layer is stuffed into the pocket.

- **One size(D6)**

D6 the one size is designed as Diaper 6.This one size diaper is fitted to the baby. Overlap layer is finished with Velcro closures.

- **Snappi (D7)**

D7 the snappi is designed as Diaper 7. Snappi is overlapped in sides. Bungee cord is used gripped plastic teeth for the diaper.

- **Fitted (D8)**

D8 the fitted is designed as Diaper 8. This is one piece diaper made entirely absorbent material. It contains a water proof layer.

- **Contour(D9)**

D9 the Contour is designed as Diaper 9. Absorbent part meant to fit easily with a pre fold cover has no elastic or closures.

- **Flat fold (D10)**

D10 the flat is designed as a diaper 10. This is a one layer fabric folded and to fit.

3.5.2 Selection of sketches

The designs were ranked according to the preference of the mothers by displaying the manually sketched designs of the Diaper. From their preference three designs were selected. Plate-II.

3.5.3 Drafting of diaper pattern

Drafting enhances the accuracy of cutting stitching and fitting of a garment (Patil et al., 2001) paper patterns were prepared for diaper based on measurements. The instruction followed as per Marry Mathew and clothdiaperwishpers.com.

3.5.4 Layout, Design and cutting of the Material

Trial Layouts were made by keeping weights or 2 pins per pattern to make sure that the cloth would be sufficient the straight grain line on patterns was kept parallel to the fabric selvedge to ensure this, the pattern was measured, adjusted and pinned on the fabrics. (Saluja, 2006).

Seam allowances width varies with the type of garment, basic seams for examples: Side seam 1-1.5 cm, no seam allowance is required on the fold line. It is

important that seam allowances added to the pattern are accurate and clearly marked Aldrich (2003).

Accordingly the patterns are placed on the fabric in the most economical way. Adequate seam allowances were left for each piece of the fabric. The pattern details such as seam line, grain line, name of the pattern and cut number were marked on the fabric. Enough material was left for facings and piping.

The drafted and altered patterns were transferred using different tools namely tailor's chalk and tracing wheel suitable for cotton bamboo material. After transferring the fabrics were cut accordingly with seam allowance.

3.5.5 Construction of Diaper

From the manual sketching the three design selected by the mothers were constructed.

Pull on Diaper (D2)

Diaper 2 is planned to be constructed as pull-on style of diaper. For this style the fabric was cut in lengthwise grain. The casing for hip line and inside leg seam was cut casing is finished along the inside leg seam and hipline and the elastic is inserted through the casing and the absorbent layer is attached to the diaper.

All in One Diaper (D3)

Diaper 3 is planned to be constructed as an All in one style of diaper. For the style the fabric was cut in length wise grain. The absorbent layer is fixed to the inside seam. This is removable layer Diaper finished with elastic along the leg seam and the Velcro closures is given.

Fitted Diaper (D8)

Diaper 8 is planned to be constructed as a fitted style of Diaper. For the fabric was cut in length wise grain.

In this style of diaper the edges are finished with piping over lapping and given Velcro closures.

3.6 NOMENCLATURE

The details of nomenclature for the sketching and diaper are given in the chapter 3 and presented in the Table-I

Table-I
NOMENCLATURE

S.No	Particulars	Nomenclature
1.	Manual sketching	D1,D2,D3,D4,D5,D6 D7,D8,D9 D10.
2.	Selected Design	D 2,D3,D8
3.	Diaper	D
4.	Cotton original	CO
5.	Cotton Desized	CD
6.	Bamboo cotton original	BO
7.	Bamboo cotton Desized	BD

3.7 EVALUATION OF THE FINISHED FABRIC

The various evaluation methods (subjective and objective) were used for the study as explained under the following heads.

3.7.1 Subjective evaluation

The subjective evaluation was carried out for both visual and sensory parameters.

3.7.1.1 Visual inspection

The samples were displayed before the mothers. An evaluation sheet was given to them. The criteria considered for the evaluation were general appearance, evenness and luster. The evaluation sheet is given in Appendix The treated samples were given to the panel of members and they were asked to feel the fabric and evaluate them. The fabric samples were to be evaluated as coarse, smooth and very smooth. In appendix 3 the performance of diaper is given .plate-III.

3.7.1.2 Wear study

In order to evaluate the performance of the developed product, three diapers were given to the three babies in the age group of 0-12 months to test its level of comfort ness. Feedback form is given in Appendix.4 and plate-IV,V,VI.

3.7.2 Objective evaluation

The objective evaluation was carried out for the fabric samples as mentioned below

3.7.2.1 Physical Property Test

3.7.2.2 Fabric weight

Fabric weight is the weight per square meter of the fabric. It may be expressed as grams per square meter. Fabric weight is the relative weight of the fabric, describes Saini (2004). Electronic weighing balance was used to determine the fabric weight directly. The samples for weighing were cut using a GSM cutter. Ten readings were observed and the mean weight was calculated and recorded.

3.7.2.3 Fabric thickness

The thickness of a textile material is the distance between the two plane parallel as the pressure foot and the other as the anvil (Jewel, 2005). Thickness is measured to an accuracy of at least 0.01mm under the prescribed pressure ranging from 0.005 psi depending on the type of fabric under test (stoker *et al.*, 2005).

The Hungarian thickness tester was used to measure the thickness. The tester was operated by hand. It has a broad anvil upon which a pressure foot is pressed by a spring. The dial has calibrations that indicate the thickness of the fabric in thousands of an inch between the anvil and the pressure foot. Each division of the dial reads 0.01mm.

The fabric to be tested is placed on the anvil and the pressure foot is lowered onto it without excess pressure. The reading pointed in the dial was recorded. The readings were taken at ten different places on the same fabric and recorded.

3.7.2.2 Mechanical property tests

3.7.2.2.1 Tensile Strength and elongation

Tensile strength is the force required to break a fabric when it is under tension (Vaishnav and Jothi, 2000). It is the resistance of the fabric to a tensile load or stress in either the warp or filling direction. Elongation is the extent to which the fabric under tension extends until it cuts off. The percentage of strength and elongation is determined by testing the fabric using a tensile strength tester.

The Eureka Pendulum Tensile strength tester was used to conduct the study. The rate of speed and capacity of the machine is 48 cm / min and 90 kg respectively. The gauge length was taken as 25 cm. The dial of the tester is calibrated in pounds and kg. There is a scale marked in inches that can be used to measure the elongation. There are two jaws; one fixed and the other one movable. The fabric sample is fixed between the two jaws. The pointer of the dial should point at zero when the test is started. The length and width of the samples were taken as 12” and 2.5” respectively. The load was applied on the fabric until the sample was torn. The reading on the dial was noted.

3.7.2.2.2 Abrasion resistance

Abrasion resistance is the ability of a fabric to resist surface wear caused by flat rubbing contact with another material (HU, 2008).

Martindale Abrasion Resistance tester was used to test the fabric samples. Ten specimens of diameter 38 mm were taken from each fabric for testing. The specimens were weighed and mounted on the four holders securely. The tester was

started to run and the number of rotations was set to 10. The abraded specimens were taken from the holder and weighed to know the loss of weight. The mean value was calculated for the recorded readings of each sample.

It was noted to determine the strength and the reading on the scale was noted as the elongation. The samples were taken both in the warp and weft directions of the fabric. Ten such observations were made and recorded.

3.7.2.2.3 Pilling

Pilling is the formation of little circular clusters of fibre on the surface of the fabric, produced as a result of the fabric being rubbed against itself or some other material (Fung, 2002).

Fabric samples were tested for pilling using a pill box which consists of twin wooden cubic boxes, each with sides about 25 cm long, the inside walls of which are lined with cork. Fabric samples were wrapped around rubber formers and placed inside the boxes, which were then rotated around a common axis for 30 minutes. The samples were then assessed on a scale of 1 to 5. The higher the rating, the lesser the pilling. Then readings were taken and tabulated.

3.7.2.3 Comfort property tests

3.7.2.3.1 Fabric Stiffness

Fabric stiffness is defined as the resistance of a fabric to bending under its own weight. The Shirley fabric stiffness tester was used to measure the stiffness of the sample. The samples were cut to the size of the template. Samples were taken in both warp and weft directions of the sample. Four ends in two sides with two ends in each side were marked as A, B, C and D. The readings were recorded for all four sides. Ten samples in each direction were taken. The tester was set on a table so that the horizontal platform and the index lines are at eye level.(song,2011).

The specimen was placed on the platform with the template on top of it, so that the leading edges coincide. The specimen and the template were slowly pushed forward until the leading edges of the specimen touch the index line. The bending length was measured. This was carried out for all the fabric samples and the mean value was calculated.(Mehta and Bhardwaj 2000).

3.7.2.3.2 Crease recovery

A crease is a line or mark produced in anything by folding. It is the deformation in a fabric intentionally formed by pressing (Operath, 2006). Crease recovery is the ability of a fabric to recover from unwanted creases. It is the property of the material to resist wrinkling and to restore the initial state after the force causing its crease is removed. Creasing of textile material is a complex effect involving tensile, flexing, compressive and other stresses. The ability of the fabric to resist creasing depends on the fibre it is made of (Tuwel, 2002).

Shirley crease recovery tester was used for the testing. The instrument has a circular dial calibrated in degrees. It has a clamp for holding the sample. A knife edge and an index line can be seen at the bottom centre of the dial to measure the recovery angle. The fabric samples each of 5 cm x 2.5 cm size were cut both in warp and weft directions. The samples were folded and creased under a load of 20 N and atmospheric conditions for a predetermined period (5 minutes). After that, the load was removed and one leg of the sample was mounted on the clamp in the tester. The fabric recovers from the crease. The dial was rotated so that the sample coincides with the knife edge. The reading that the index line points was recorded as the crease recovery angle. Ten samples were taken from each direction of the fabric. The mean value was calculated for all the samples and recorded.

3.7.2.3.3 Drape

Drape is the ability of bending behavior of fabric under its own weight to assume a graceful appearance in use (Hu, 2004).

Eureka Drape meter was used to determine the drapeability of the fabric samples. Specimens were cut using the template. A brown paper was also cut to the same size and weighed using an electronic weighing balance. The test specimens were placed on the circular disc in the drape meter and operated. The image of the draped sample was traced on the brown paper and it was cut on the outline and weighed. Then the brown paper was cut to the size of the supporting disc in the meter and again weighed. The drape coefficient for each sample was calculated using the recorded readings by applying the following formula. (kenkare and plumlee,2005)

$$\text{Drape coefficient} = \frac{\text{Initial weight} - \text{final weight}}{\text{Initial weight}} \times 100$$

3.7.2.3.4 Air permeability

Air permeability is the volume of air in millimeters which is passed in one second through 100S/mm² of the fabric at a pressure difference of 10mm head of water (Jewel,2005)In the British standards test the air flow through a given area of fabric was measure data constant pressure drop across the fabric of 10mm head of water. The specimen was clamped over the air inlet of the apparatus with the use of rubber gaskets and air was sucked through it by means of a pump. The air value was adjusted to give a pressure drop across the fabric of 10mm head of water and the air flow was then measured using a flow meter.

3.7.2.4Absorbency tests

3.7.2.4.1 Drop test

The drop test is a count of number of drops required to penetrate through to the underside of the fabric when the entire drop falls on the same spot, describes Jewel (2005). The ability of a fiber to take up moisture is determined as absorbency.

For this test burette filled with distilled water was clamped in a stand. The fabric sample was mounted in a conical flask, covering the mouth of the flask and secured with a rubber band and was placed at the base of the stand. The distance between the sample and burette nozzle was kept constant. The nozzle of the burette was opened to allow a drop of water to fall on the sample. The stop watch was started simultaneously and it was stopped when the drop of water fully sank into the material. The time taken for this was noted. The same procedure was repeated for ten samples of the same material and the mean value was calculated and recorded.

3.7.2.4.2 Sinking test

Sinking test is a test for wet ability of the fabric. Samples were prepared in sizes of about 5cm x 5cm. Distilled water was taken in a glass beaker. The samples were dropped on the water one by one. The stop watch was started when the fabric struck the surface of the water and stopped when the last corner sank below the

water surface. The time taken by each sample to sink was noted. The mean value was calculated for all the ten samples and recorded in seconds.

3.7.2.2.3 Wicking test

Wicking test is a test that helps to measure the rapidity of absorption, says Paul (2005). The samples were prepared with a dimension of 15 cm length and 2.5 cm width. A mark was made at 1cm from one end of the sample. The other end of the sample strip was hoisted with a glass rod which was placed across the beaker. The sample was left to dip in the wafer such that the surface of the water was in line with the 1 cm mark made on the fabric. The rise of the water level on the sample was noted after 30 minutes keeping the time constant. The measurement was made starting from the 1cm mark to the extent up to which the sample was wet. The readings were recorded and the mean value was calculated. A total of ten samples were tested, recorded and expressed in centimeters.

3.8 Statistical analysis

Statistical is the science of collecting, analyzing and making inference from data. Statistical methods and analyses are often used to communicate research findings and to support hypotheses and give creditability to research methodology and conclusion. The most common summary statistic for determining the central position of distribution is arithmetic mean, often simply called the average and the most common summary statistics for determining the dispersion of a distribution is the standard deviation. The arithmetic mean and the standard deviation can be thought of as the average distance of the observations from the arithmetic mean. The arithmetic mean and the standard deviation can be seen as sibling measures for describing a distribution (Kohler and kreuter,(2005)

3.9 Cost Estimation

The cost of the constructed diapers was calculated and recorded.

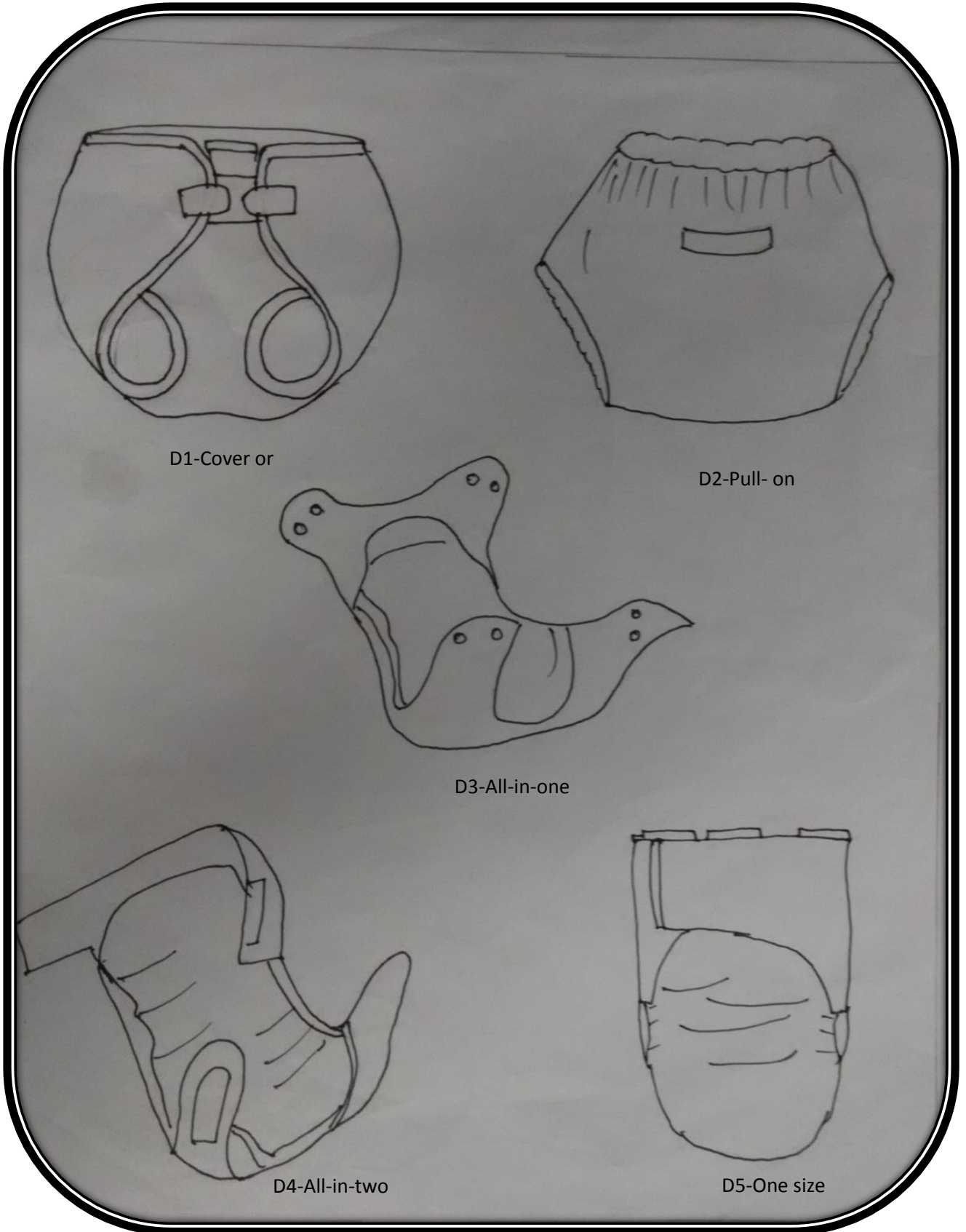


Plate I- Manual sketching of diaper

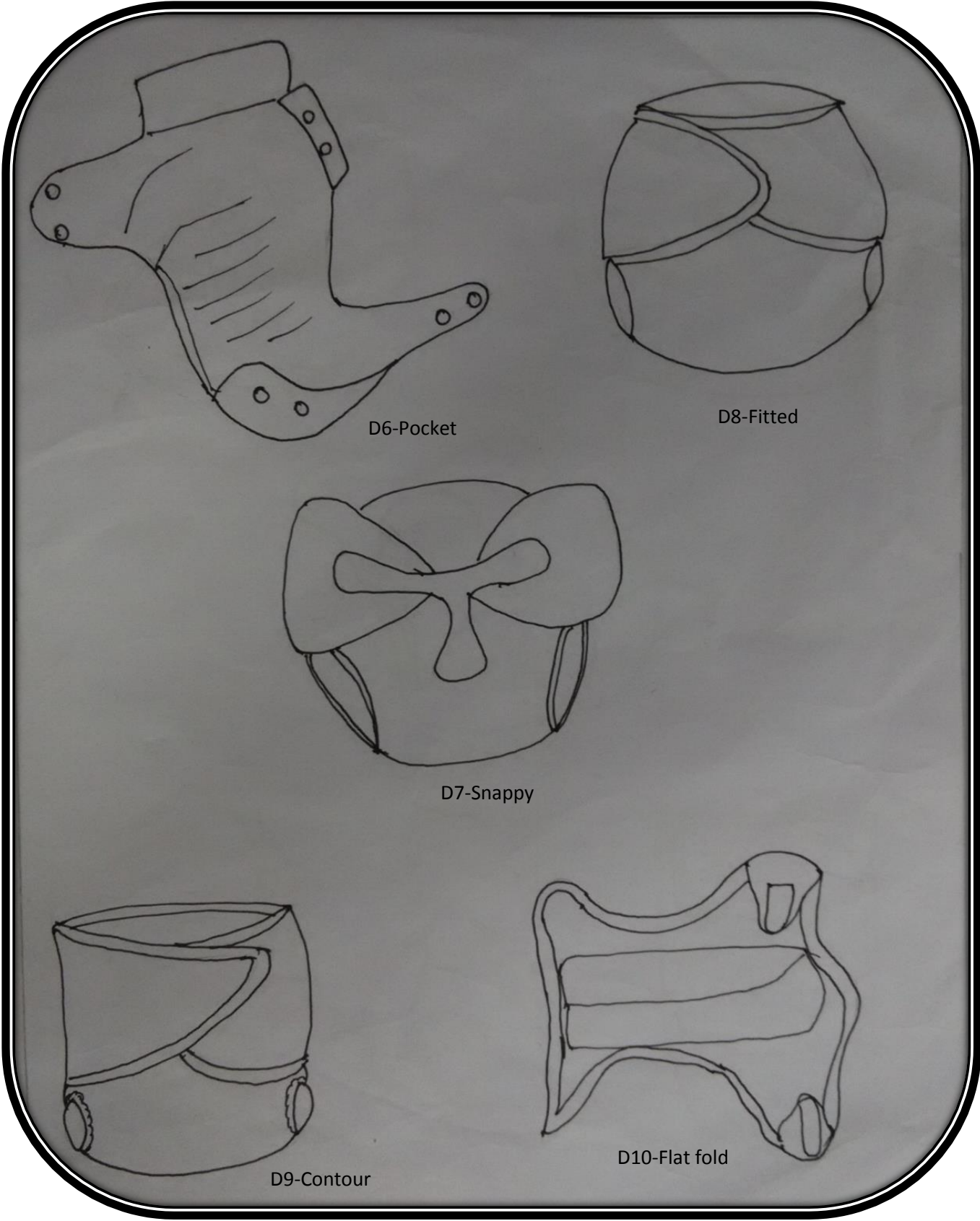
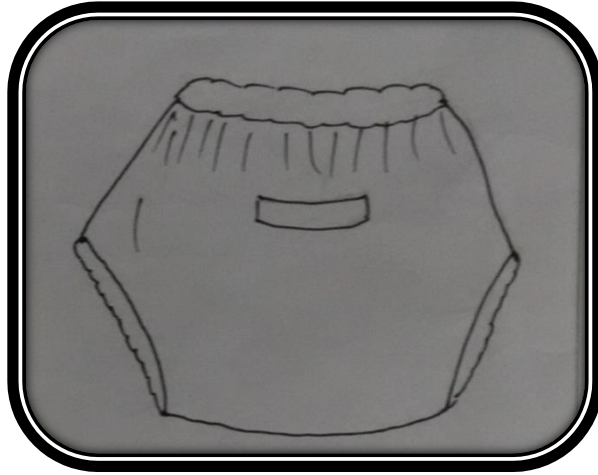
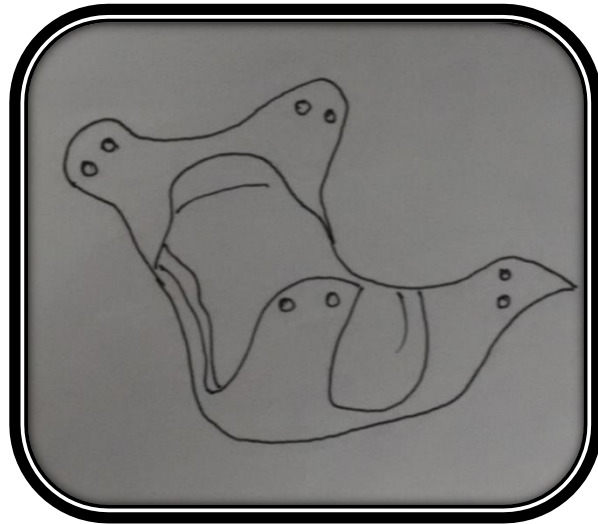


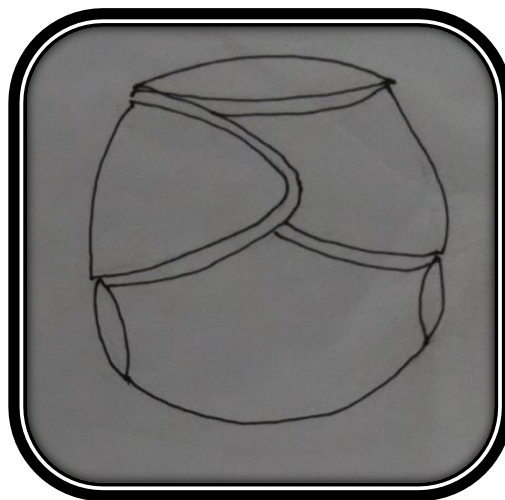
Plate I- Manual sketching for diaper



D2- Pull on



D3- All-in-one



D8- Fitted

Plate II- Selection of sketches



Plate III-Visual inspection



Plate IV-D2-Pull on diaper



Plate V-D3-All in one diaper



Plate VI- D8- Fitted diaper

IV. Result and Discussion

The obtained results are discussed on “**Designing of Non Disposable baby diapers using cotton and bamboo cotton woven fabrics**” under the following headings.

4.1 opinion of mother

- 4.1.1 Preference of diaper
- 4.1.2 Types of Diaper
- 4.1.3 Preference for cloth diaper
- 4.1.4 Preference for disposable
- 4.1.5 Fabric preference for cloth diaper
- 4.1.6 Preference of diaper style

4.2 Consolidation of Manual Sketching

4.3 Subjective Evaluation

- 4.3.1 Visual Inspection
- 4.3.2 Wear study

4.4 Objective Evaluation

- 4.4.1 Physical Properties Test
- 4.4.2 Mechanical Properties Test
- 4.4.3 Comfortable Properties Test
- 4.4.4 Absorbency Test

4.1 Opinion of mothers

The Results obtained from the survey conducted among the mothers of the babies are presented and discuss under the following headings:

4.1.1 Preference of diaper

The preference of the mother's regarding the baby diaper is presented in Table-II and Figure-6

Table-II

S.NO	PREFERENCE	PERCENT
1	Yes	98
2	No	2

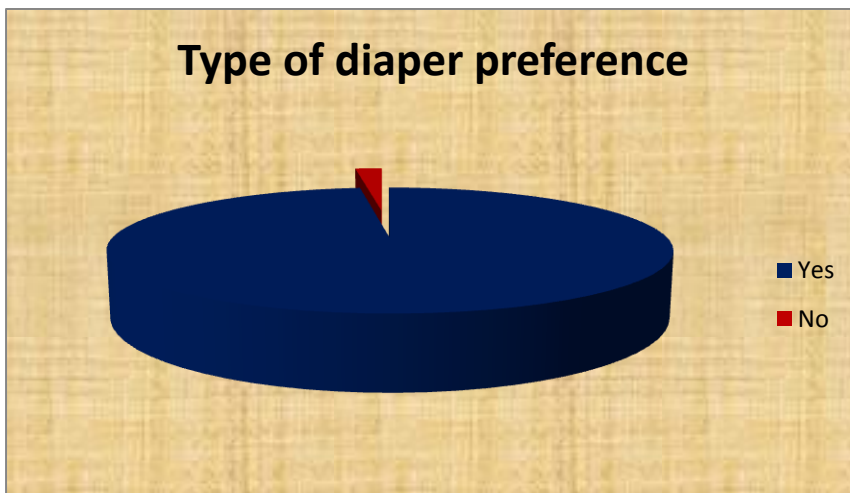


Figure 6

From the Table –II and figure-6 it is clear that 98% of mothers preferred diaper for her babies and 2% of mothers do not prefer diaper for baby.

4.1.2 Type of Diaper preferred

The preference of the mothers for style of diaper for their babies is presented in the Table-III and Figure-7

Table-III

S.NO	TYPE OF DIAPER	PERCENTAGE
1	Disposable Diaper	28
2	Non Disposable Diaper(cloth diaper)	70
3	Super absorbent Diapers	2

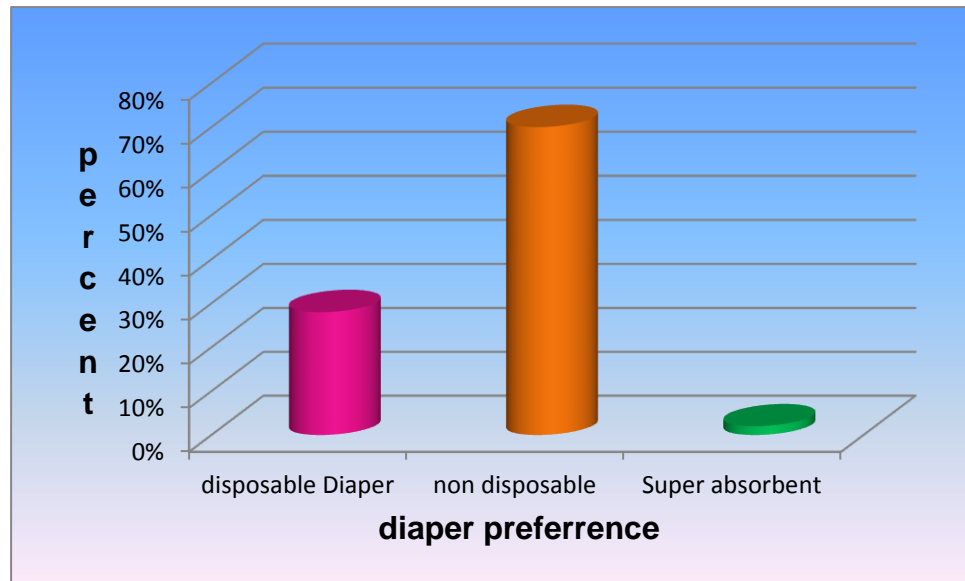


Figure 7 Type of diaper preference

From the table –III and Figure -7 It is clear that 70% of mothers preferred non-disposables (cloth diaper) and 28% preferred disposable Diapers for their babies. The mother super absorbent Diaper was selected by 12% of mothers for their babies.

4.1.3 Preference for Non disposable (Cloth) Diaper

The preference of the mothers for purchasing cloth diaper material for babies is presented in Table-IV and figure-8

Table-IV

S.NO	SELECTION OF MATERIAL	PERCENTAGE
1	Non woven	0
2	Woven	84
3	Knitted	16

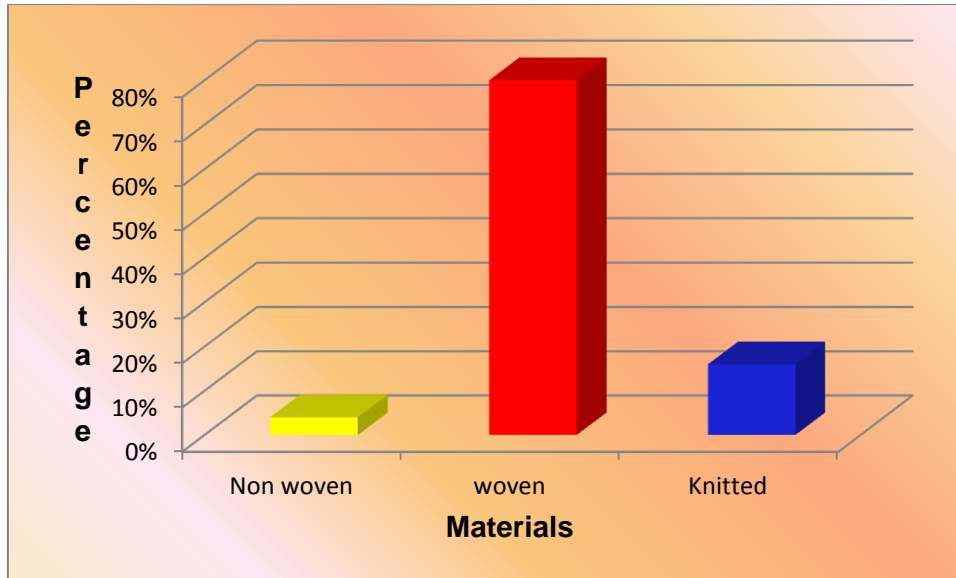


Figure 8 Preference of Material

From the table-IV and Figure-8 It is clear that 84% of mother's preferred woven fabrics for cloth diapers and 16% of mothers preferred Knitted material for cloth diaper for her babies.

4.1.4 Preferences for disposable diaper

The preference of the mothers for the disposable diapers is given in Table-V and figure-9

Table-V

S.NO	PREFERENCE OF DISPOSABLE DIAPER	PERCENTAGE
1	Economical	28
2	Easy to Dispose	52
3	Comfort to use	20

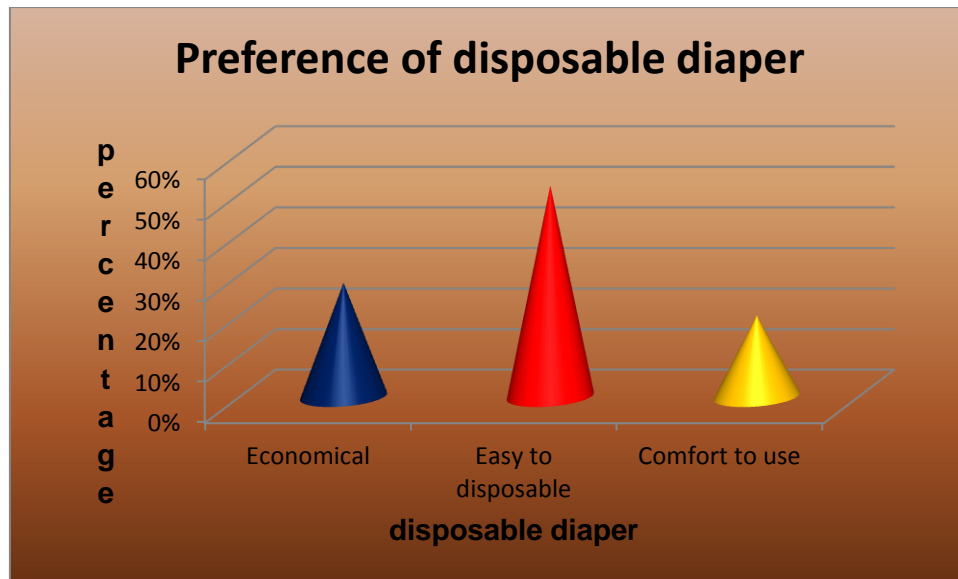


Figure 9 Preference for disposable diaper

From the table-V and Figure-9 It is clear that 52% of mother's preferred disposable diaper as it is easy to dispose and 28% of the mothers preferred for economical reason. The other (20%) preferred due to comfortable reasons.

4.1.5 Fabric preferred for cloth Diaper

The preference of the mothers for cloth diaper material is presented in the Table-VI and Figure-10

Table-VI

S.NO	FABRIC PREFERED	PERCENTAGE
1	Bamboo cotton	35
2	Cotton	60
3	Synthetic	5
4	others	0

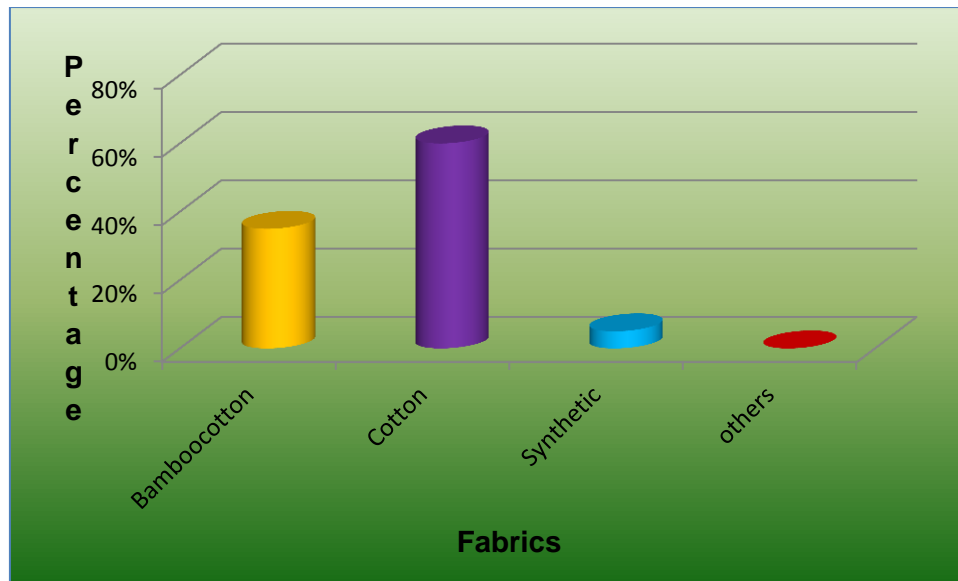


Figure 10 Preference of fabric

From the Table-VI and Figure- 10 It is clear that 60% of the mother's preferred cotton material for the Cloth diapers and 35% of mother's preferred Bamboo .the other 5% preferred synthetics for baby diapers.

4.1.6 Preference of diaper style

The preference of the mothers for the style of diapers for their babies is presented In Table-VII and Figure-11

Table-VII

S.NO	DIAPER STYLE	PREFERENCE	PERCENTAGE
1	Cover or warp D1	3	6
2	Pull on D2	13	26
3	All-in-one D3	12	24
4	All-in-Two D4	2	4
5	Pocket D5	2	4
6	One size D6	2	4
7	Snappy D7	2	4
8	Fitted D8	10	20
9	Contour D9	2	4
10	Flat fold D10	2	4

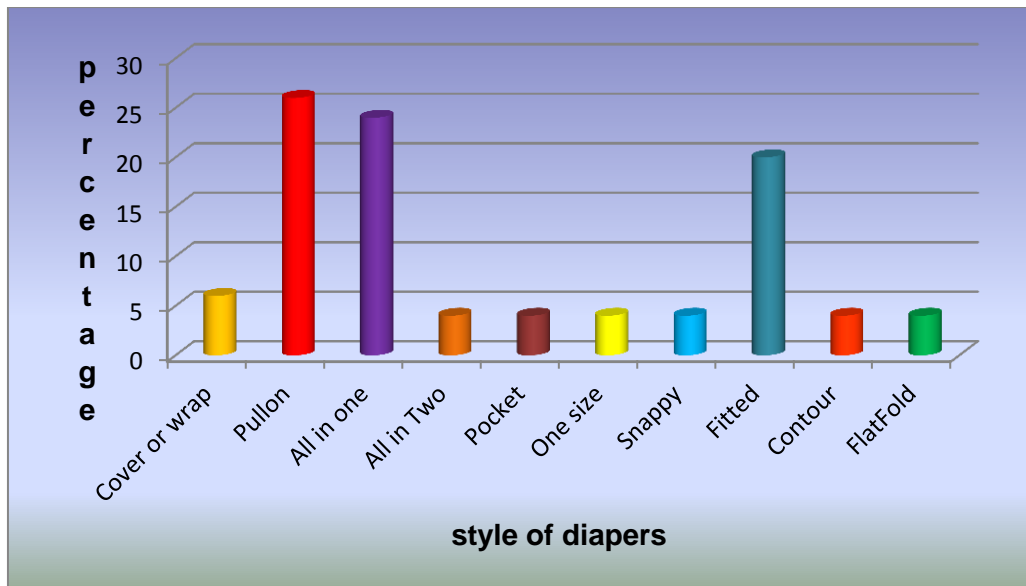


Figure-11 Style of diaper preference

From the Table VII and Figure 11 It is clear that 26%of mothers preferred pull-on diapers and 24% of mothers preferred All in one diapers, 20% of mothers preferred. Fitted diapers for her babies, 4%and 6% preferred respectively.

4.2 CONSOLIDATION OF MANUAL SKETCHING

Consolidated rating of sketching are presented under the Table VIII

Table VIII Consolidated rating of Sketching

S.NO1	DESIGN CODE	EXCELLENT	GOOD	FAIR
1	D1	86.2	10.4	3.4
2	D2	90.3	9.7	-
3	D3	94.6	5.4	-
4	D4	86.6	11.1	2.3
5	D5	73.3	26.7	-
6	D6	66.6	30.0	3.4
7	D7	71.4	2.35	5.1
8	D8	89.3	8.07	2
9	D9	60.5	25.2	14.3
10	D10	55.2	34.4	15.5

From the Table, it is obvious that the maximum rating of 94.6 percent was noted for the design D3 as excellent followed by the designs D2 (90.3), D8 (89.3), D4 (86.6) D1 (86.2) respectively. The designs namely D5, D6, D7, D8, D9, D10 Were rated to be excellent for general appearance by 50-80 percent of judges.

Hence it could be concluded that three of the designs namely D2, D3, D8 had excellent general appearance.

4.3 Subjective Evaluation

4.3.1 VISUAL INSPECTION

The visual inspection of Non disposable diapers presented under the Table IX

Table IX Visual Inspection of Non disposable diapers

S.No	Design code	Design				Overall Appearance			
		Excellent	Very good	Good	Fair	Excellent	Very good	Good	Fair
1	D2	72	28	10	-	86	14	-	-
2	D3	90	10	-	-	95	5	-	-
3	D8	86	10	4	-	80	12	8	-

From the Table It is clear that maximum of 90 percent of judges rated D3 as excellent in design followed by the diapers D2 and D8 with 86 and 72 percentages respectively.

The overall appearance was rated as excellent by 95 percent of judges for the D3 and 86 percent for D2 and 80 for D8 respectively.

4.3.2Wear study

The constructed diapers were given to the babies for wear study. The babies were asked to wear the diapers for 4 hours. The wear study report is shown. Table-X and Figure 12

Table-X

S.NO	SAMPLE	COMFORT			FEEL			ABSORBENCY		
		Excellent	Good	Fair	Excellent	Good	Fair	Excellent	Good	Fair
1	D2	98	2	-	95	5		100	-	-
2	D3	92	8	-	96	4		98	2	-
3	D8	80	18	2	89	9	2	98	2	-

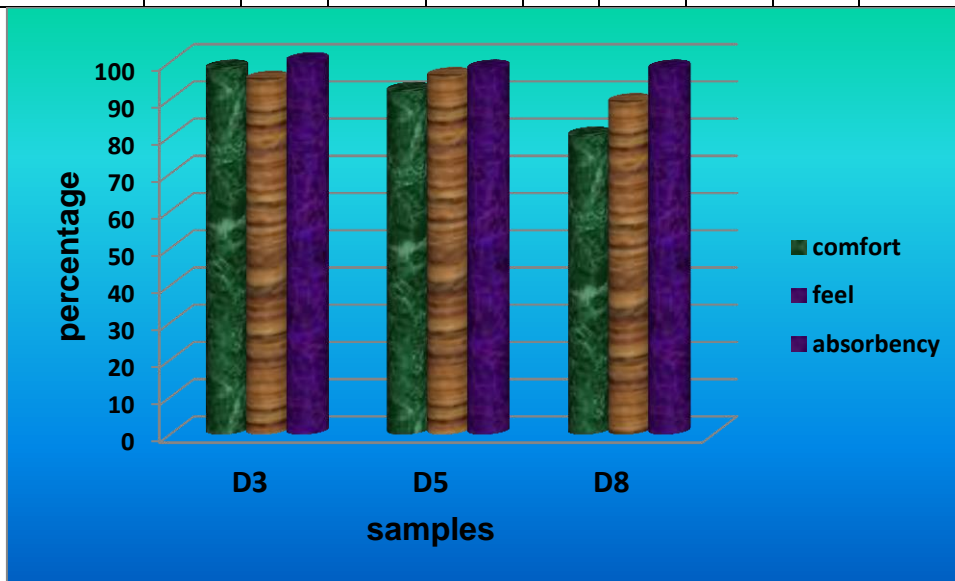


Figure-12 Wear study

Table X and Figure12 exhibits the comfort, feel and absorbency properties of the selected diapers D2, D3, and D8 from the collected data, it is observed that maximum of judges had rated all the samples to be excellent in its properties. The sample D2, D3, and D8 has been rated Excellent by 98, 92, and 80 percent of the judges regarding comfort property. Maximum Excellency with respect to the feel has been suggested by 95, 96 and 89% of judges, where as absorbency has been rated excellent by 100, 98, and 98 percent of judges for D2, D3, and D8 diapers. From these results it is evident that all the constructed diapers had exhibited well results regarding its comfort properties, among which the maximum preference is observed in sample D2 followed by samples D3 and then D8. Consequently, it adds on to the result that, eco-friendly woven diapers has shown good efficiency in comfort.

4.4 OBJECTIVE EVALUATION

4.4.1 PHYSICAL PROPERTIES

4.4.1.1 FABRIC WEIGHT

The fabric weight and analysis of variance of original fabric and de sized fabric of cotton and bamboo cotton are shown in Table XI and Figure13

Table XI

S.No	Sample	mean (gsm)	Loss or gain	or Loss or gain percentage (%)	F-value
1	CO	1.6280			
2	CD	1.6620	0.034	3.4	4.313 ^{NS}
3	BO	1.1620			
4	BD	1.1852	0.0214	18.388	0.119 ^{NS}

CO and BO - Non significant

From the Table XI and Figure 13, it is clear that the weight of the samples original CO was 1.6280 grams and BO was 1.1620 had shown in a consistent increase in weight by 3.4 and 18.3 percent. The statistical analysis showed that it was not significant with F value of 4.313 and 0.119 comparison made between original and desized samples.

Hence it could be concluded that when compared to cotton and bamboo cotton, cotton has shown increase in weight.

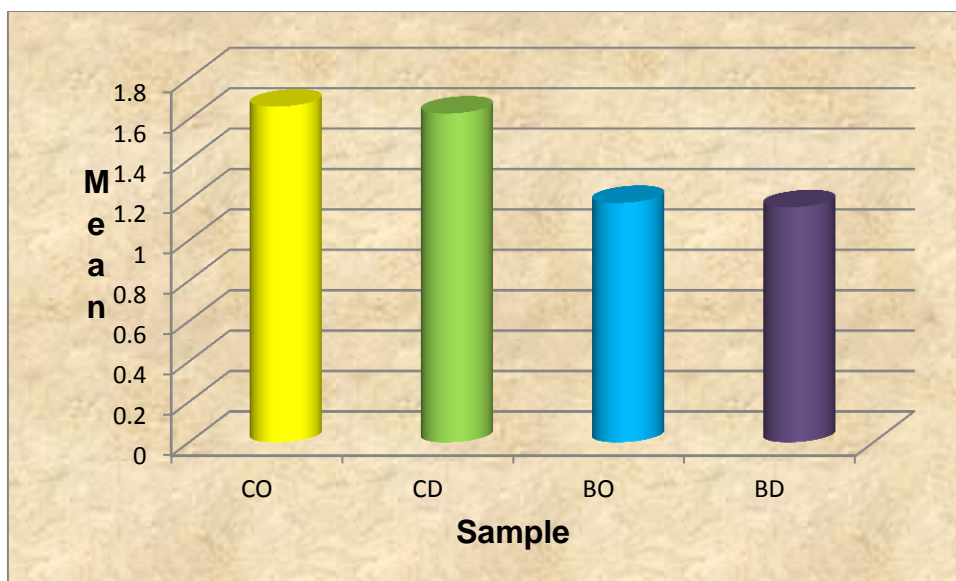


Figure 13 Fabric Weight

4.4.1.2 FABRIC THICKNESS

The fabric thickness and analysis of variance of original fabric and desized fabric of cotton and bamboo cotton are shown in Table XII and Figure 14

Table XII

S.No	Sample	Mean (mm)	Loss or gain	Loss or gain percentage	F-value
	CO	0.2380			
	CD	0.2220	0.016	6.722	5.333 ^{NS}
	BO	0.2360			
	BD	0.2920	0.056	23.72	19.60 ^{**}

Cotton –Non significant, ** Significant at 1% level

From the Table XII Figure 14, the fabric thickness has increased in bamboo cotton desized when compare to the bamboo cotton original by 23.72 percent. Cotton desized decreased compared to cotton original by 6.722 percent. The statistical analysis showed that there was one percent level value with f value of 19.60 in bamboo cotton and the statistical analysis of cotton is not significant with F value in the comparison of original and pre treated samples.

Hence it could be concluded that the thickness is increased in bamboo cotton.

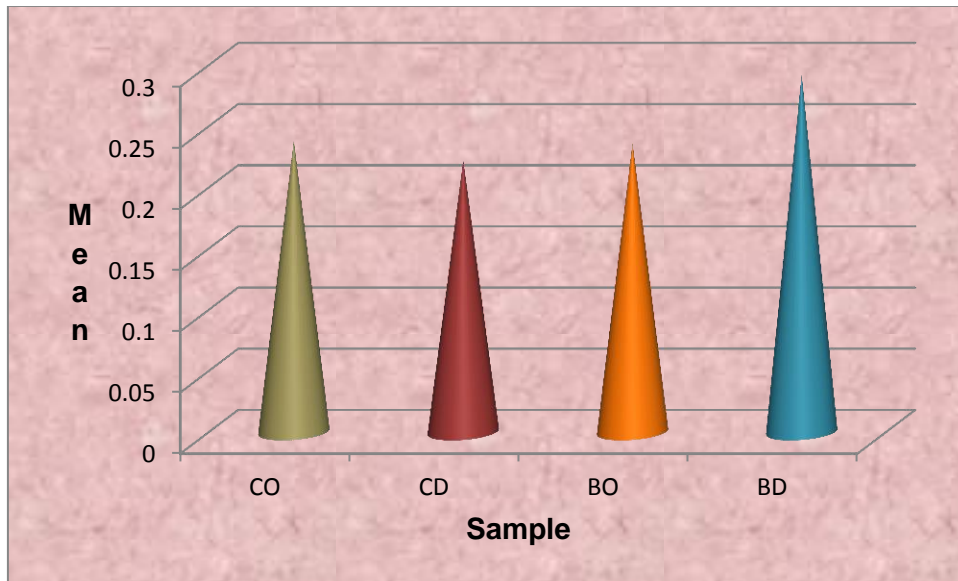


Figure-14 Fabric Thickness

4.4.2 MECHANICAL PROPERTY TEST

4.4.2.1 TENSILE STRENGTH IN WARP DIRECTION

The fabric Tensile Strength and analysis of variance of original fabric and desized fabric of cotton and bamboo cotton are shown in Table XIII and Figure 15

Table XIII

S.No	Sample	Mean (kg)	Loss or gain	Loss or gain percentage (%)	F-value
	CO	28			
	DO	25.4	2.6	9.28	8.61**
	BO	30.4			
	BD	26.4	4	13.15	10.52**

**** Significant at 1% level**

From the Table XIII and Figure-15 the fabric Tensile strength of the CO were 28kg and the desized 25.4 kg resulting to a decrease in strength by 9.28 percent. There for it is clear that, the strength of the samples CD and BD has decreased

when compare to CO and BO, this may presence of starch in the original fabric which gives a strong binding. The statistical analysis shows that there is a one percent significant level with F value of 8.61 and 10.52 in the comparison of original and desized samples.

Hence it could be concluded that decreased strength in warp direction.

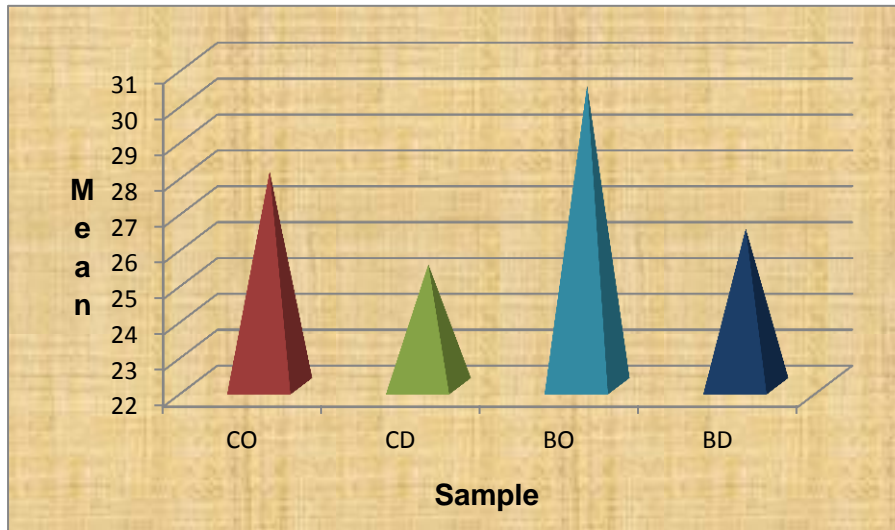


Figure 15 Tensile Strength Warp direction

4.4. 2.2 TENSILE STRENGTH IN WEFT DIRECTION

The fabric tensile strength and analysis of variance of original fabric and desized fabric of cotton and bamboo cotton are shown in the Table XIV and Figure16

Table XIV

S.No	Sample	Mean (kg)	Loss or gain	or	Loss or gain percentage (%)	F value
1	CO	16.6				
2	CD	27.9	11.3		0.68	100.5**
3	BO	20.8				
4	BD	24.4	3.6		0.173	32.40**

** Significant at 1% level

From the Table XIV and Figure 16, show that the Tensile Strength of the sample CO was 16.6 kg and desized sample were 27.9 kg resulting to a increase in strength by 0.68 percent CD and 0.173 percent BD. The strength of the sample was slightly increased in bamboo cotton .The statistical analysis show that the one percent significant level with F value of 100.5for cotton and 32.40 for bamboo cotton in the comparison made between original and desized

Hence it could be concluded that desized cotton strength is increased compare to bamboo cotton.

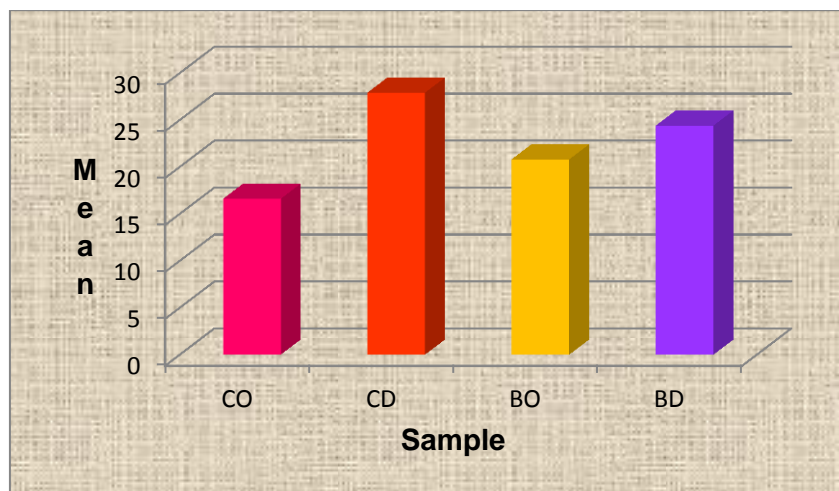


Figure 16 Tensile Strength weft directions

4.4.2.3 ELONGATION WARP DIRECTION

The fabric elongation and analysis of variance of original and desized fabric of cotton and bamboo cotton are shown in Table XV and Figure 17

Table XV

S.No	Sample	Mean (%)	Loss or gain	or	Loss or gain percentage (%)	F-value
1	CO	0.940				
2	CD	0.88	0.063		6.38	0.277 ^{NS}
3	BO	1.740				
	BCD	2.120	0.38		21.839	12.033 ^{**}

Cotton-Non significant, ** Significant at 1% level

From the Table XV and Figure 17, it shows that the fabric elongation warp direction of the sample CO, CD, BO, and BCD was 0.940, 0.88, 1.740, and 2.120 inch respectively. there by showing an increased in bamboo cotton and cotton original 21.83 and 6.38. Therefore it is clear that the elongation of BCD increased compare to all samples. The statistical analysis shows that there is a one percent significant level with F value of 12.033 and another analysis shows a not significant for 0.277 in the comparison made between original and desized samples

Hence the warp direction shows an increase in elongation in bamboo cotton desized fabrics.

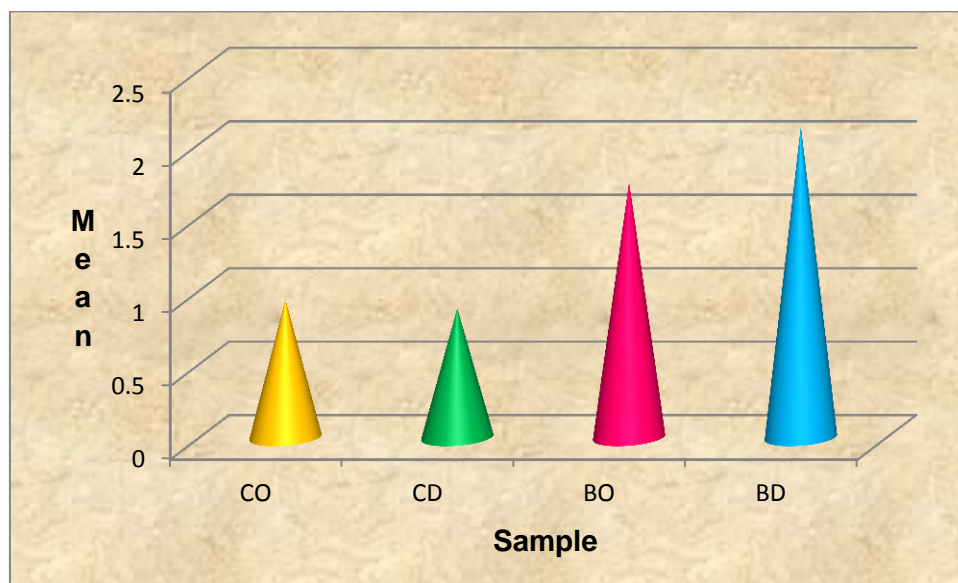


Figure 17 Elongation in warp direction

4.4.2.4 ELONGATION OF WEFT DIRECTION

The fabric elongation and analysis of variance of original fabric and desized fabric of cotton and bamboo cotton are shown in Table XVI and Figure 18

Table XVI

S.No	Sample	Mean (%)	Loss or gain	Loss or gain percentage (%)	F-value
1	CO	1.040			
2	DO	0.960	0.08	0.0769	0.627 ^{NS}
3	BO	2.70			
4	BO	2.32	0.38	21.89	17.190 ^{**}

Cotton-Non significant, ** Significant at 1%

From the Table XVI and Figure 18 It is clear that the fabric elongation weft of the sample CO,CD,BO, and BCD was 1.0400,0.96,2.70and 2.32 they are showing a increase in bamboo original, CO, CD, BO, and BCD samples were 0.769, and 21.89 percent. Therefore, it is clear that elongation of the samples. The statistical analysis shows that there is a one percent significant level with F value of 17.190 and the cotton analysis shows that not significant value 0.627 in the comparison made between the original and desized samples.

Hence it could be concluded that bamboo cotton original increased in elongation.

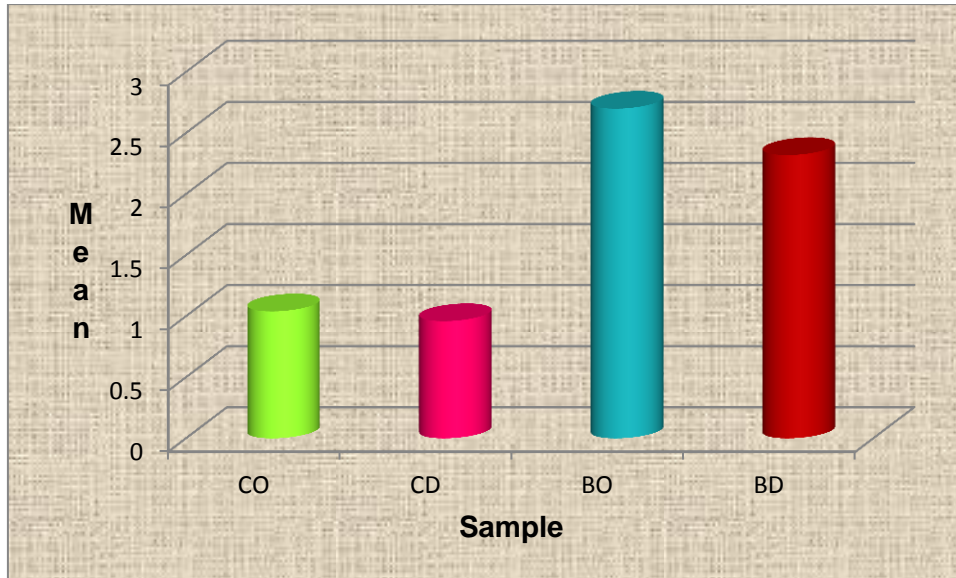


Figure 18 Elongation weft directions

4.4.2.5 ABRASION RESISTANT

The fabric abrasion resistant and analysis of variance of original fabric and desized fabric of cotton and bamboo cotton are shown in Table XVII and Figure 19

Table XVII

S.No	Sample	Mean	Loss or gain	Loss or gain percentage	F-value
1	CO	0.006			
2	CD	0.007	0.001	17	12.4**
3	BO	0.016			
4	BCD	0.018	0.009	12.8	10.9**

** Significant at 1% level

From the Table XVII and Figure 19, it is obvious that the abrasion value of the samples CD, BO, BCD, shows a greater resistance of 0.07, 0.16, and 0.18 respectively. Compare to bamboo cotton original, bamboo cotton desized is increased and their percentage gain was found 17 percent and cotton is 12.8 percent CD and BCD increased in strength. The statistical analysis showed that there was

the one percent significant level with the F value 12.4 and 10.9 with the comparison made between original and desized samples

Hence it could be that desized samples showed good abrasion.

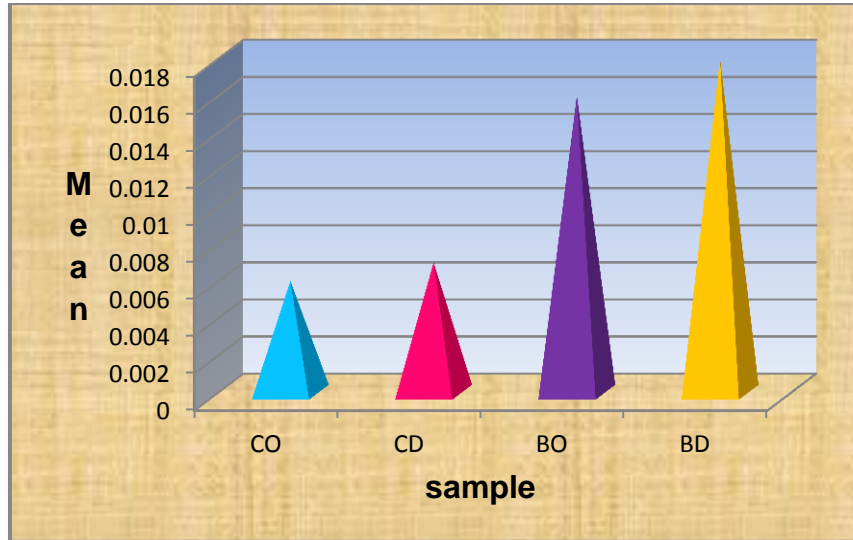


Figure-19 Abrasion resistance

4.4.2.6 PILLING

The fabric pilling and analyzed of variance of cotton and Bamboo cotton original and desized are shown in Table XVIII

Table XVIII

S.NO	Sample	Grade
1	CO	5 (No change)
2	CD	4 (slight pilling)
3	BO	5 (No change)
4	BD	5 (No Change)

From the Table XVIII, it is obvious that the grading for the original samples CO and BO was 5 but case of treated samples CD it was rated to be 4 and BD it was ranked 5.

Hence it could be concluded that slight pilling was observed in desized samples.

4.4.3 COMFORT PROPERTY TEST

4.4.3.1 FABRIC STIFFNESS WARP DIRECTION

The fabric stiffness and analysis of variance of cotton and bamboo cotton original fabric and desized fabric are shown in Table XI X Figure 20

Table XIX

S.No	Sample	Mean (cm)	Loss or gain	Loss gain percentage (%)	F-value
1	CO	2.2400			
2	CD	2.650	0.41	18.30	0.258 ^{NS}
3	BO	2.200			
4	BD	2.740	0.54	2.45	0.37 ^{NS}

Cotton and bamboo cotton-Non significant

It is obvious from the Table XIX and Figure 20 that the fabric stiffness of desized fabrics compared to original CD and BD increase in cm. The percentage of stiffness increased samples (CD,BD) original was calculated to be 18.30 and 2.45. The statistical analysis showed that there was No significant difference with Fvalue 0.258 and 0.37 in the comparison made between the original and desized samples.

Hence it could be concluded that desized cotton fabric and bamboo cotton desized was increased fabric stiffness in warp direction.

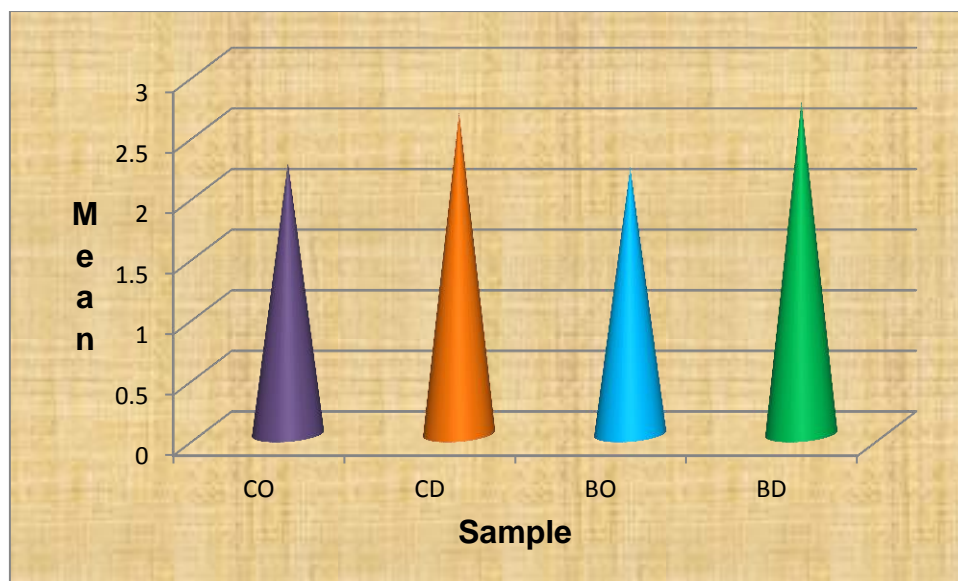


Figure 20 Stiffness warp direction

4.4.3.2 FABRIC STIFFNESS WEFT DIRECTION

The fabric stiffness and analysis of variance of cotton and bamboo cotton original and desized are shown in the Table XX and Figure 21

Table XX

S.No	Sample	Mean (cm)	Loss or gain	Loss or gain percent (%)	F-value
1	CO	2.710			
2	CD	2.630	0.08	2.9	0.522 ^{NS}
3	BO	2.808			
4	BD	2.814	0.00213	0.21367	0.966 ^{NS}

Cotton and Bamboo cotton –Non significant

From the Table XX and Figure 21 the fabric stiffness of desized fabrics compare to originals decreased in cotton 2.6300 the original 2.7100 .bamboo cotton

stiffness of BO 2.8080cm and the desized 2.8140 increased in weight .0.21367 and CD 29 percent decreased. This decreased in fabric stiffness may be due to removal of starch .the statistical analysis showed the there was no significant in both fabrics with F values comparison between original and treated.

Hence it could be concluded the bamboo cotton was increased in stiffness, cotton was decreased in fabric stiffness weft.

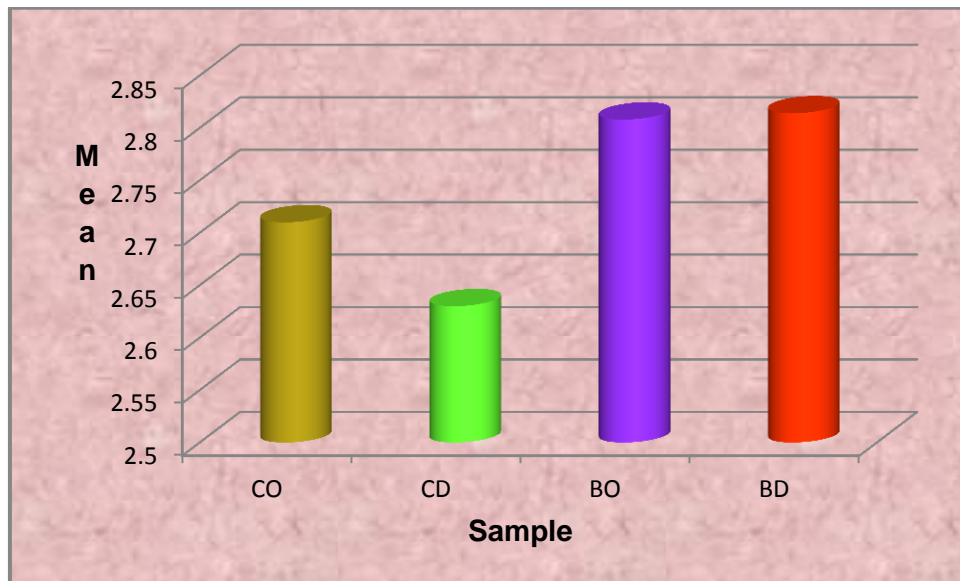


Figure 21 Stiffness weft direction

4.4.3.3 CREASE RECOVERY WARP DIRECTION

The Fabric crease and analysis of variance of cotton and bamboo cotton original and desized are shown in Table XXI and Figure 22

Table XXI

S.NO	Sample	Mean (angle)	Loss or gain	Loss or percent age (%)	F- value
1	CO	57.20			
2	CD	60.40	3.2	5.59	3.657 ^{NS}
3	BO	91.20			
4	BD	74.25	17	18.64	0.276 ^{NS}

Cotton and bamboo cotton –Non significant

It is evident that the crease recovery warp of the samples CO was 57.2 angle for CD,BO and BD were 60.40,91.20, and 74.25respectively.the samples show an increased in crease .when compare to original by 5.59 and 18.64 percent. The statistical analysis showed that there was No significant in both the fabric samples.

Hence it could be concluded that that cotton desized and bamboo cotton original are increased fabrics in warp direction.

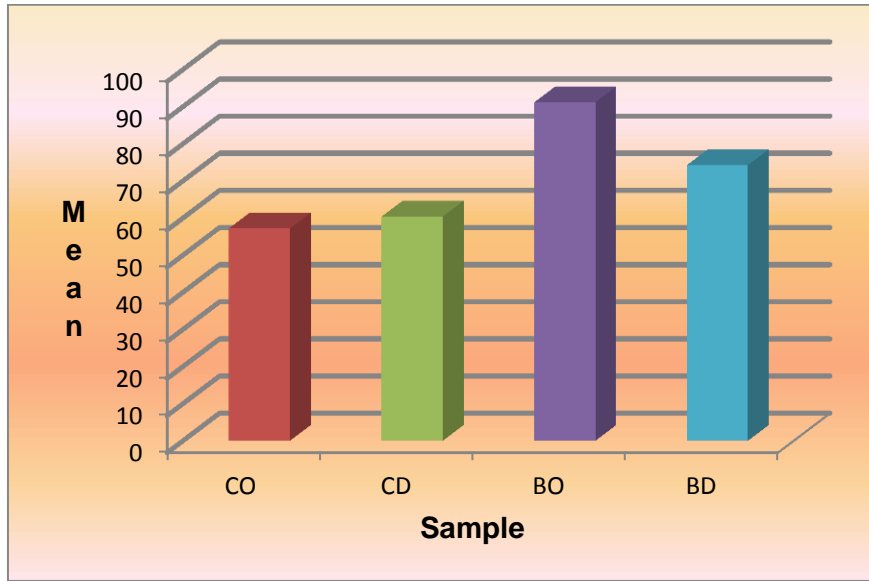


Figure 22 Crease recovery warp direction

4.4.3.4CREASE RECOVERY WEFT DIRECTION

The fabric crease and analysis of variance of cotton and bamboo cotton original and desized are shown in Table XXII and Figure23.

S.NO	Sample	Mean (angle)	Loss or gain	Loss or gain percentage (%)	F-value
1	CO	67.80			
2	CD	101.00	33.2	48.96	74.3**
3	BO	110.60			
4	BD	94.80	5.8	14.28	0.16 ^{NS}

Cotton –Non significant, **Significant at 1% level

It is clear that the crease recovery weft of the sample CO was 67.8 and BO was 110.60. the sample CD was increased in crease .BD was decreased compare to BO. The statistical analysis showed that there was the significant one percent difference between original and pre treated samples. The F value 74.3. and the bamboo cotton statistical analysis showed not in significant comparison of original and treated.

Hence it could be cotton is increased and bamboo cotton is decreased in warp direction.

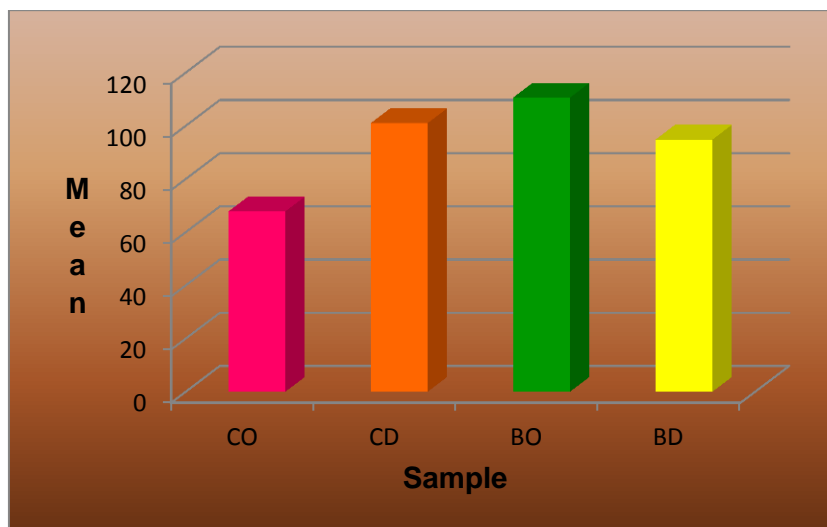


Figure 23 Crease recovery weft directions

4.4.3.5 FABRIC DRAPE

The fabric drape and analysis of variance of cotton and bamboo cotton original and desized are shown in Table XXIII and Figure 24

S.NO	Sample	Mean (%)	Loss or gain	Loss or gain percentage (%)	F-value
1	CO	55.8666			
2	CD	53.478	2.388	4.2749	1.184 ^{NS}
3	BO	71.500			
4	BD	62.0565	0.13216	13.216	0.08 ^{NS}

Cotton and bamboo cotton Non significant

From the Table XXIII and Figure 24, it is perceptible that the drapability the samples CO was 55.866.and BO was 71.500. the desized fabrics are decreased in a drape of 2.388 and 0.13216.compare to original both fabrics are decreased in drape the reason for decrease the fabric original having a starch. The statistical analysis shows the both samples are Not significant with the F value of 1.184 and 0.08 in comparison between original and desized.

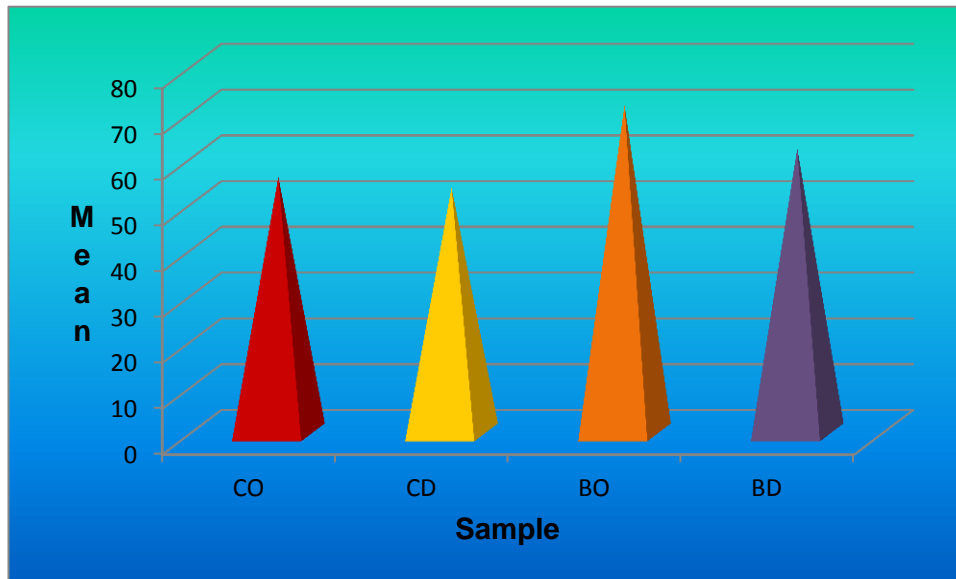


Figure 23 Fabric Drape

4.4.3.6AIR PERMIBILITY TEST

The fabric air permeability level and analysis of cotton and bamboo cotton original and desized are shown in Table XXIV and Figure 25

Table XXIV

S.NO	Sample	Mean (mm)	Loss or gain	or	Loss or gain percentage (%)	F-value
1	CO	95.3				
2	CD	96.7	1.4		1.469	0.54 ^{NS}
3	BO	98.2				
4	BD	100.4	2.2		2.240	0.46 ^{NS}

Cotton and bamboo cotton –Non significant

From the Table XXIV and Figure 25 the fabric the original samples of CO and BO was 95.3 and 98.2 compare to original both are increased in compare to original. The statistical analysis of the samples both is not significant with F value 0.54 and 0.46 compared original and desized.

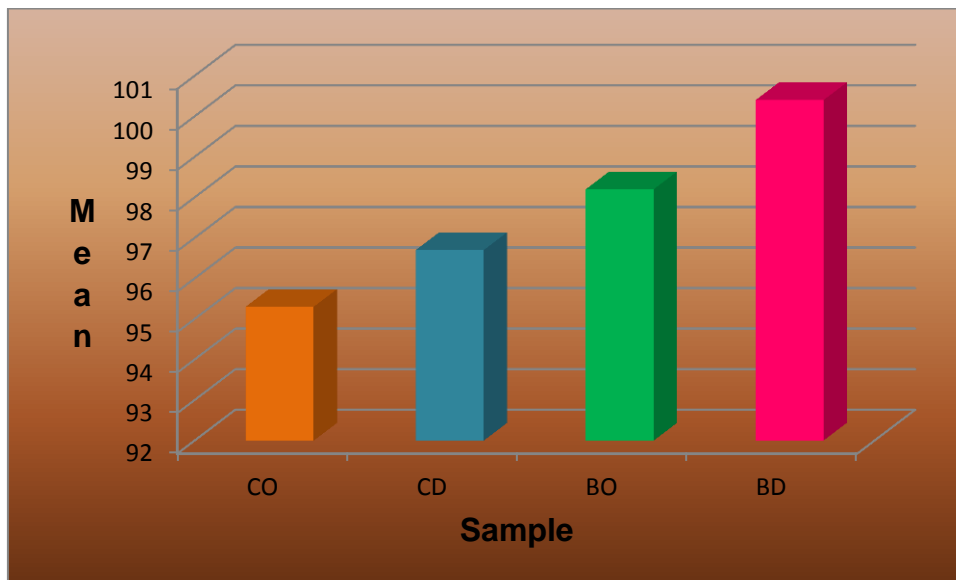


Figure25 Air permeability

4.4.4 ABSORBENCY TESTS

4.4.4.1 DROP TEST

The fabric absorbency and analysis of variance of cotton and bamboo cotton original and desized are shown in Table XXV and Figure 26

Table XXV

S.NO	Sample	Mean (Sec)	Loss or gain	or	Loss or gain percentage (%)	F-value
1	CO	5.89				
2	CD	3.23	2.66		43.2	13.05**
3	BO	8.34				
4	BD	4.23	4.11		49.28	10.22**

** Significant at 1% level

From the Table XXV and Figure 26 It is clear that the time taken for the drop to penetrate into original sample was CO 5.89; BO was 8.34 seconds which drastically reduced in the sample CD and BD the statically analysis that there is one percent significant in original and treated.

Hence it could be concluded that the sample of bamboo cotton good in absorbency.

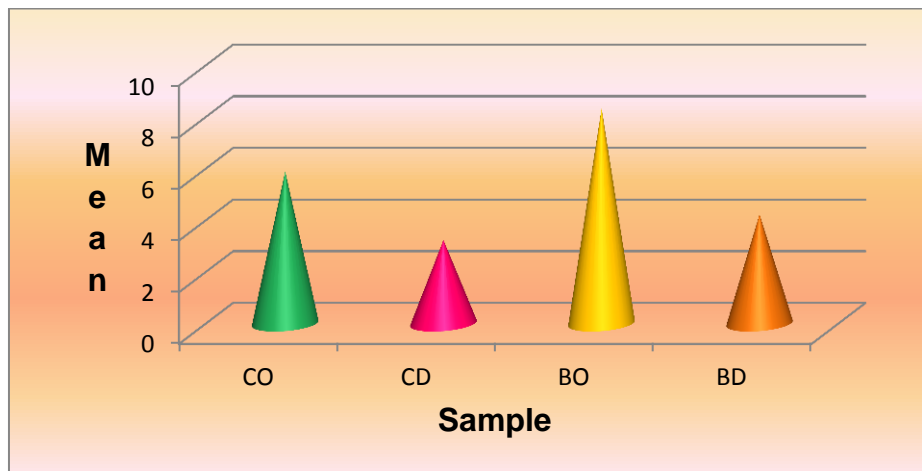


Figure 25 Drop Test

4.4.4.2 SINKING TEST

The fabric sinking and analysis of variance of cotton and bamboo cotton original and desized shown in Table XXVI and Figure 27

S.No	Sample	Mean	Loss or gain	Loss or gain percentage (%)	F-value
1	CO	0.5400			
2	CD	6.2520	0.288	53.33	126.149**
3	BO	1.5000			
4	BD	1.7600	0.26	17.83	0.290 ^{NS}

Bamboo cotton Non significant, ** Significant at 1% level

From the Table XXVI and Figure 27 it is obvious that the desized sample CD and BD took for a (6 seconds), to sink compare to the original fabric CO, BO which took for a 54 seconds and 1.5 sec for bamboo cotton. The statistically analysis of

cotton shows the one percent significant .and bamboo cotton not significant compare to original and desized.

Hence it could be concluded that samples of CD and BD after desizing the absorbency is increased.

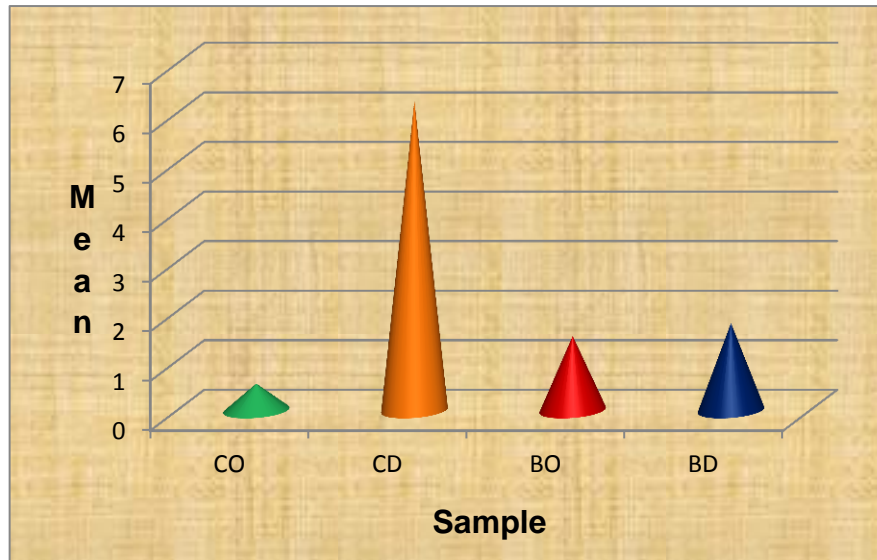


Figure 27 Sinking Test

4.4.4.3 WICKING

The fabric wicking and analysis of variance of cotton and bamboo cotton original and desized are shown in Table XXVII and Figure 28

Table XXVII

S.No	Sample	Mean	Loss or gain	Loss or gain percentage	F-value
1	CO	2.000			
2	CD	2.2200	222	11.1	1.690 ^{NS}
3	BO	11.000			
4	BD	9.800	1.2	61.38	0.141 ^{NS}

Cotton and bamboo cotton –Non significant

From the Table XXVII and Figure 28, it is clear that the wicking ability of the desized sample CD is increased in cotton. In bamboo cotton has decreased. The

statistical analysis of the samples both samples are not in significant compare to original and desized.

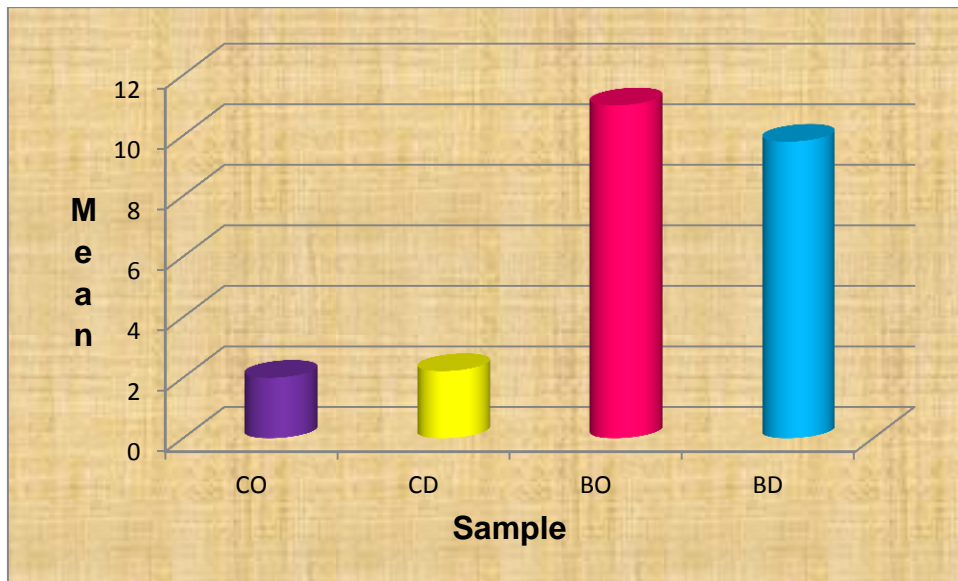


Figure-28 Wicking Test

4.5 COST ESTIMATION

The cost estimation is presented in Table XXVIII

Table XXVIII

S.NO	Diaper Code	Particulars	Cost	Total Cost
1	D2	Material cost	50	120
		Stitching Charge	50	
		Fasteners	20	
2	D3	Material cost	50	100
		Stitching charge	50	
		Fastener charge	10	
3	D8	Material cost	70	140
		Stitching charge	50	
		Fastener charge	20	

From the Table XXVIII, it is clear that the cost of the diapers D2, D3, and D8 are Rs.120, Rs.100, and Rs.140 respectively. Hence it could be concluded that the cost of constructed diapers were more economical.

5. SUMMARY AND CONCLUSION

Clothes are made up of fabric selected mainly for their preference and properties. Clothes are worn by people for various reasons. The use of the clothing is protection, modesty and self adornment .Clothing is important interface between the human and environment clothing helps you to maintain your property body temperature.

Babies need layer of clothing that can be removed or added easily. These layer clothes to regulate their body temperature. Baby clothes made out of material that is soft, pliable, and absorbent. The materials are durable, easily laundered. The clothing should be light weight and sufficient to keep the body at the normal temperature of 98.6⁰.

Diaper is a kind of underwear that allows one to defecate or urinate in a discreet manner. Diapers are made of cloth or synthetic disposable materials. Disposable diapers are commonly used and these diapers are highly absorbent and convenient. Disposable keep the baby skin dries. Disposable diapers generally are not considered biodegradable. These diaper contain super absorbent material (gel form) the gel they often contain bad for environment Chemicals used in the manufacture of high absorbent disposable diaper sodium poly acrylate were used that contain toxic (shock syndrome) and can lead to sensitivity.

Cloth diaper is reusable and can be made from natural fibers, manmade materials, or a combination of both. Cloth diapers are usually composed of layer of fabrics such as cotton, hemp, bamboo, or microfibers and washed and reused. Cloth diapers are environment friendly dumping virtually nothing at landfills and not contributing to pollution. It is guaranteed to glide smoothly on baby skin. Cotton and other natural fibers breathe easier.

Cotton fabrics combine durability with wearing quality and comfortable. Cotton strength and absorbency makes a fabric for medical and personal hygiene product. Absorbent cotton will retain 24-27 times its own weight in water and is stronger when wet than dry. Cotton is a non-allergenic natural fiber that does not irritate the sensitive skin. Cottons softness makes it a preferred fabric for under garments and other skin close garments Cotton keeps the body cool in summer and warm in winter

because it is a good conductor of heat. Cotton's strength and absorbency make it an ideal fabric for medical and personal hygiene products such as bandages and swabs.

Bamboo fabric is exceptionally soft, and light, almost silky in feel. This makes it breathable and cool to wear. It is 60% more hygroscopic than cotton. . The ultraviolet nature is sustainable to make summer cloth especially for the pregnant ladies and children's from ultraviolet radiation. It has a good moisture absorption and ventilation. Bamboo is highly water absorbent and able to take up three times its weight in water. Bamboo also has many anti-bacterial qualities, Anti-bacteria, anti-bacterio static and deodorization even after 50 times of washing the bamboo fabric.

Considering the above facts, the investigator decided to study on **“Designing of Non disposable baby diapers using cotton and bamboo cotton woven fabrics”** with the following Objectives.

- To study and select eco-friendly fabrics suitable for baby diapers
- To construct baby diapers using the selected fabrics
- To compare and evaluate the baby diapers

METHODOLOGY

The methodology pertaining to the study **“Designing of Non disposable baby diapers using cotton and bamboo cotton woven fabrics”** is presented in the following steps.

- The investigator prepared a questionnaire to conduct the survey. The survey was done to collect information regarding the mothers' preferences. The data collected was tabulated and analyzed.
- The investigator used simple random method of sampling to gather information for study. The necessary data were collected and recorded personally.
- Cotton and Bamboo cotton fabric were selected for properties such as eco-friendly, and bio degradable, skin friendly.
- Non disposable diaper type was selected for environmental reasons.

- The designs for non disposable diapers were developed by manual sketching. The sketches were prepared for 10 different styles, such as cover or wrap, pull-on, All-in one, All-in Two, Pocket, One size, Snappi, Fitted, Condor, Flat fold.
- Three designs were selected for the diaper through manual sketching which were selected based on the mother`s preference.
- The investigator had drawn 10 designs manually. Then the designs were ranked according to the preference of the subjects by displaying manually sketched designs. From their preferences,3 designs were selected for construction.
- Diaper 2 constructed as pull-on style of diaper. For this style the fabric was cut in lengthwise grain. The casing for hip line and inside leg seam was cut casing is finished along the inside leg seam and hipline and the elastic is inserted through the casing and the absorbent layer is attached to the diaper
- Diaper 3 constructed as an All in one style of diaper. For the style the fabric was cut in length wise grain. The absorbent layer is fixed to the inside seam. This is removable layer Diaper finished with elastic along the leg seam and the Velcro closures is given.
- Diaper 8 is planned to be constructed as a fitted style of Diaper. For the fabric was cut in length wise grain.
- In this style of diaper the edges are finished with piping over lapping and given Velcro closures.
- Finished diapers were evaluated subjectively and objectively
- The visual inspection was made for the diapers by judges by making the subjects selected babies wear the diapers.
- In objective evaluation Fabric strength, Crease recovery, Abrasion resistant, Pilling, Fabric strength, stiffness sinking, wicking These test are used for evaluation.

FINDING STUDY

- In survey 98% of mothers preferred Non disposable (cloth) diapers for her baby
- In survey 84% of mothers preferred woven fabrics for cloth diapers.

- Fabric weight of bamboo cotton is increased compared to cotton.
- Thickness of the desized bamboo cotton is increased
- The strength of the warp and weft the bamboo cotton strength is higher than cotton.
- The elongation is increased in cotton and bamboo cotton fabrics. Compare to cotton bamboo cotton elongation is high.
- Slight pilling was found in all fabrics.
- The fabric stiffness in bamboo cotton and cotton increased in desized samples.
- The crease recovery of the fabric warp increased in bamboo cotton desized, cotton is decreased. The fabric weft cotton desized increased and bamboo cotton is increased.
- The pretreated samples were increased in drape compare to bamboo cotton is more increased.
- Air permeability of bamboo cotton increased compared to cotton, both desized fabrics are increased.
- bamboo cotton ranked highest rate of absorbency

CONCLUSION

The bamboo cotton showed good results in absorbency, strength, abrasion resistant, Air permeability. This fabric is more suitable for baby diapers. This fabric is soft and has natural antibacterial properties. These diapers do not contain chemicals so these diapers are baby friendly and reusable. These are 100% biodegradable. These diapers are eco friendly dumping virtually nothing at landfills and not contributing pollution. Hence this Non Disposable diapers were widely preferred by mothers. The constructed Non disposable diapers have a huge market. Hence this product can be commercialized

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APPENDIX-I

QUESTIONNAIRE ELICIT INFORMATION MOTHERS PREFERENCE ON BABY DIAPERS

1. Name:

2. Age:

3. Gender: Female

4. Do you prefer diaper for your baby?

- Yes No

5. What type of diaper do you prefer?

- Disposable diapers Non disposable diapers (cloth)
 super adsorbent diapers

6. Which type of material do you prefer for cloth diapers?

- Non woven Woven Knitted

7. Do you prefer using a cloth diaper for your baby?

- Yes No

8. Why do you choose disposable diaper?

- Economical easy to dispose comfort to use

9. How frequently do you change your baby diaper?

10. Mention price range do you prefer for diaper?

11. Does the baby feel uncomfortable wearing a diaper?

- Yes No

If yes, mention:

- Skin irritation skin allergy odour smell

12. Do you know the health hazards of using a disposable diaper?

- Yes No

If yes, mention:

13. Do you feel the price of commercial diaper is costly?

- Yes No

14. Have you heard about cloth diaper?

- Yes No

If yes

The type of fabric do you preferred?

- Bamboo Cotton Synthetic none

15. Please tick the diaper style do you prefer and feel comfortable?



Cover or wrap



pull-on



All-in-one



All-in-two



pocket



one size



o Snappy



o fitted



o Contour



o flat fold

APPENDIX-II

Visual inspection

S.No	Design code	Design				Overall Appearance			
		Ex	VG	G	F	EX	VG	G	F

Ex - Excellent

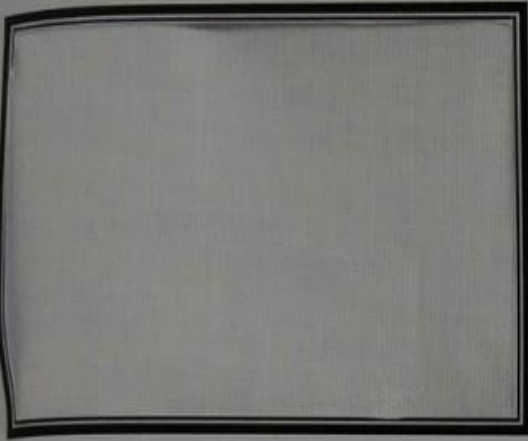
VG - very Good

G - Good

F - Fair

APPENDIX - IV

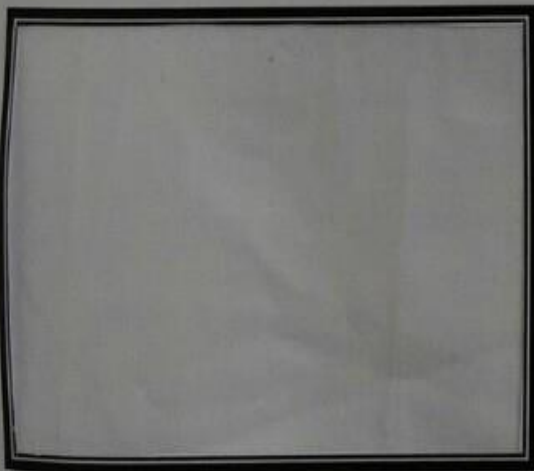
Details of the fabric sample



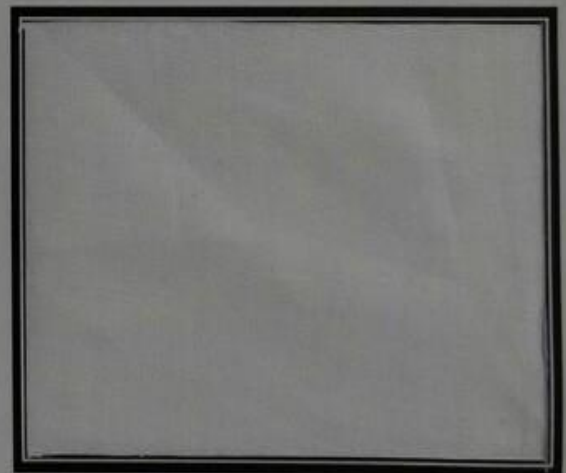
Cotton –original



Cotton -Desized



Bamboo cotton-original



Bamboo cotton- Desized