

DESIGN AND DEVELOPMENT OF ECO-FRIENDLY TRAVEL NAPPIES WITH WIPES

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ABSTRACT

Clinical material is one of the most flexible enterprises, where it is utilized from the underground diggers' suit to space transport. Clinical material has accomplished fast development in recent years. The fundamental reasons for clinical material are insurance, cleanliness, solace, and skin health management.

Venturing out assists with creating oneself, to make new companions, to revive one's psyche and to communicate inventive thoughts. It gives the individual another environment that lifts him out of his usual range of familiarity. Voyaging extends the point of view of individuals. Individuals travel around twolong outings each year or one little excursion a month.

Expendable nappies are particularly valuable on the off chance that they voyaging, as the requirement for evolving, washing, and drying is eliminated. Likewise, the danger of reusing nappies might prompt mold, bacterial diseases, skin issues and surprisingly a foul smell because of incessant cleaning. Accordingly, in this report the dispensable diaper construction and materials utilized in each layer are changed for better solace, airtight, speedy ingestion, and skin fit. The motivation behind this article is to deliver diapers for voyagers.

Keyword: Top sheet, Super Absorbent Polymer, Bio plastic, Coconut husk powder and Wet wipes

1. INTRODUCTION

The invention of disposable diapers dates back to late 1940s. Johnson & Johnson introduced first mass-market disposable diaper in the U.S. in 1948. In 1956, P&G engineer Victor Mills developed a project to investigate disposable diapers. P&G initially developed a two-piece diaper featuring a folded insert. later, P&G focused on rectangle shaped diaper consisting of a hydrophobic rayon liner to hold moisture in the diaper and plastic-based outer layer. Its edges were pleated to provide a better fit around the legs, and it was attached with safety pins. It was named "Pampers."

A competition is prevailing in recent time, for making biodegradable, eco-friendly diaper. Conventional diaper comes in various styles and materials, accounting for the comfort and handling. The use of disposable diapers has offered improved health care

benefits. The skin is more prone to nappy rash. The modern age disposable diapers, when compared to cloth nappy, showed good absorbency and reduced skin problem. Also, disposable diapers contain Super Absorbent Material (SAM) that successfully reduces the incidence of nappy rash. Anti-bacterial finish is an important phenomenon of hygiene products. Some natural anti-bacterial finishes are associated with heavy odour and fails to attain its objectives. The odour itself will be nauseating. A good anti-bacterial finish results in pleasant-feeling wearer. The fastening mechanism of the diaper or nappy influences the position in which it is fastened around waist. Any deviation in the position of wearer should not reflect in the primary function of diaper or nappy. So, a fastener also plays a crucial role in diaper.

1.1 PROBLEM DEFINITION

Traveling is the joyful part of life; people travel a long distance to satisfy their self. Around 60 – 75% of travelling people get Urinary Tract Infection because of unavailability of clean restrooms or restrooms on their way of travel. Using of diaper/ nappy is the one of the solutions for the problem.

In case of disposable diaper, there is super absorbent polymer in its core which traps the liquid in it and makes the diaper and skin dry. In this way, the germ deposition and rashes are reduced. The need for laundering is eliminated.

Using adult diapers, incontinence underwear, or pads can lead to diaper rash in adults. It causes problems such as skin irritation from trapped heat and moisture, skin barrier damage from chafing or rubbing, inflammation caused by the ammonia in trapped urine or the enzymes in stools, which damage skin tissues when in close contact with the skin

1.2. OBJECTIVE

1. To design and develop pattern of Nappies.
2. To use bamboo fibre in the absorbent layer and bio plastic as waterproof layer.
3. To impart **Cocos nucifera husk** antibacterial, antifungal finish to top sheets.
4. To impart wet wipes to nappy

2. LITERATURE REVIEW

Travel is the joyful part of life; people travel a long distance. People travel to satisfy their personal pleasure and willingness. It says a normal human being is willing to go at least two long trips/year, one small trip/month or a travel of 4-5 hours for relaxation and refreshment. People travel for around 4-10 hours maximum.

The diaper is intended for hospitals an elderly care unit and increase the quality of service for the patients. The diaper system is well suited for incorporating into existing intelligent healthcare systems. Absorbent hygiene products [1] ranging from disposable to non-disposable ones are designed to receive, absorb, and keep body fluids and solid wastage. The products include baby diapers, sanitary napkins, tampons, incontinence products, panty shields, and wipes which are mostly single-use items. Disposable diapers consist of layers made of a specific raw material working complementarily to each other to guarantee serviceability of the end products. Disposable diapers consist of the following raw materials: (I) a nonwoven nylon, polypropylene (PP) or polyethylene (PE) sheet used as a liquid permeable membrane lining of the inside surface/top sheet; (ii) a PP, PE, starch, wove cloth or rubber membrane on the outer surface/back sheet; (iii) a fibrous material (cellulosic fluff pulp, hemp, or synthetic materials) enclosed in water- resistant paper, the absorbent core; (iv) a superabsorbent polymer suspended on the absorbent core (AC) and (v) finally, minor amounts of tapes, elastics, spandex, pigments, and adhesive material.

2.1 NATURAL FIBRE

Regular fiber demonstrates better over artificial filaments. Not just it is useful for bio degradable property yet in addition it has great solace property. This article [2] states that normal banana fiber and hemp fiber has been utilized to make the center of the diaper taking out the very permeable polymers making the item biodegradable. The shrewd diaper idea has been presented by fusing conductive yarn with the assistance of incorporated innovation which ready to detect and distinguish dampness level of diaper. This alteration can likewise assist with serving the physiological requirements of the patients and give answer for self-restraint the Executives.

2.1.1 PROPERTIES OF BAMBOO FIBRE

Sameen Ruqia Imadi recommended that bamboo is an incredible forthcoming green fiber with extraordinary biodegradable material, having strength identical to customary glass filaments. Bamboo utilized for fiber readiness is typically, 3-4 years of age. Fiber is delivered through soluble hydrolysis and multi-stage fading of bamboo stems and leaves followed by compound treatment of boring mash created during the interaction. Bamboo fiber has different miniature holes, which make it milder than cotton and increment its dampness assimilation. They are flexible, climate well disposed, and biodegradable. The fiber is bacteriostatic, antifungal, antibacterial, hypoallergenic, hygroscopic, normal deodorizer, and safe against bright light. Besides, it is profoundly strong, steady, and extreme and has significant rigidity. Because of its adaptable properties, bamboo strands are utilized for the most part in the material industry for making clothing types, towels, and wraparounds. Because of its antibacterial nature, it is utilized for making wraps, veils, nurture wears, and clean napkins. UV-confirmation, anti- infection and bacteriostatic drapes, TV covers, and backdrops, and numerous different things are additionally ready from bamboo strands to reduce the impacts of microbes and damage of bright radiations on humans.

Bamboo filaments are likewise utilized for enhancement reasons. Prakash C recommended that bamboo strands have surprising breathability and coolness. Since the cross-part of the bamboo fiber is loaded up with different miniature holes and miniature openings, it has much better dampness assimilation and ventilation. With this unrivaled miniature design, bamboo fiber attire can assimilate and vanish people's sweat in a brief instant. Very much like breathing, such pieces of clothing cause individuals to feel incredibly cool and agreeable in the blistering summer. It is never adhering to the skin even in sweltering summer. Clothes produced using bamboo strands are 1-2 degrees lower than typical clothes in warm summer. Clothing produced using bamboo fiber is delegated as Air Conditioning Dress.

2.2 BAMBOO FIBRE

G.Malarvizhi [3] said that Bamboo fibre have amazing wet permeability, vapor transmission properties. It is a recently established, extraordinary forthcoming green textile. Bamboo has the capacity of antibiosis, bacteriostasis. The top sheet of diaper was made of 19 GSM polypropylene, spongy center is made of bamboo and wood mash, back sheet as non-woven polypropylene.

The bamboo fiber fused with wood mash at the proportion 30:70 showed great sponginess property. The other physical properties like thickness, size, shape, and smell were to some extent. The after effects of research study showed that the antibacterial completed child diaper diminished medical issue and created eco- friendly items.

The hybrid top sheet [4] was created by cotton non-woven fabric to keep the top sheet dry. Three unique mixes of center layer were attempted by sandwiching SAP (Super Absorbent Polymer) sheet between cotton, bamboo, and a mix of cotton/bamboo (50/50). Biodegradable polyethylene plastic was utilized as boundary layer.

The attributes of bamboo fiber based on its origin whether it is of natural or regenerated. It is produced by following process:

- Natural (bast) fibre via physical and chemical treatments
- Regenerated (pulp) fibre via retting bamboo plant to pulp

The previous methods produce unadulterated bamboo fibre of 2mm staple length, the latter produces bamboo viscose filament which is changed over to staple filaments whenever required. For extraction of bamboo fiber from bamboo Culm, the two cycles initiate with parting of bamboo strips straightforwardly from bamboo bunch, to eliminate stomach and hub. Contingent on end use, it is exposed to substance or mechanical handling. The diaper pad composed of pure bamboo fibre is lighter as compared to all other products. Absorption capacity is higher for the diapers made of bamboo/organic cotton (70/30) and pure bamboo. Acquisition time under load is lowest for the diapers composed of both 70/30 and 50/50 proportions of bamboo/organic cotton blends. It is highest for pad made of pure bamboo.

2.3 PROPERTIES OF DISPOSABLE DIAPERS

Assessment of the Impact of 2 Disposable Diapers in the "Natural" Diaper Category on Diapered Skin Condition. Robert J. O'Connor in the article [5], concentrated on the performance of dispensable diapers. Diaper performance was evaluated dependent on skin stamping appraisals, scored by a prepared grader, and frequency of diaper dermatitis. Skin reviewing for diaper dermatitis was evaluated at 4 destinations in the diaper region. The new diaper offering was related with less skin stamping and altogether less diaper rash at the privates and intertriginous areas versus the comparator. This information recommend that the new diaper gave significant improvement in both skin marking and prevalence of diaper rash. Expendable Diaper Absorbency: Improvements through Advanced Designs. C. Tucker Holmes [6] contrasted the absorbency of diapers with designs. With innovative highlights, many driving items keep up with their dryness performance throughout night. Considering the significance of holding fluid away from the skin, continuous examination in diaper development centers around techniques to expand the viability to catch fluid and help keep away from rewetting of skin. The format and plan of a dispensable diaper takes into consideration dispersion of absorbency features where they can provide the optimal benefit. Clinical evidence indicates materials can keep moisture away from the skin in the diapered area helping maintain proper skin hydration, minimizing irritation, and contributing to reduced rates of diaper rash. The multifaceted development [7] involves a first layer contacting a body, being a polyester wicking texture. The center layer related with the principal layer. The center layer being significantly absorbent and portrayed by the presence of viscose fiber to increase absorbency. It has waterproof external layer.

Regular fiber demonstrates better over artificial filaments. Not just it is useful for bio degradable property yet in addition it has great solace property. This article [8] states that normal banana fiber and hemp fiber has been utilized to make the center of the diaper taking out the very permeable polymers making the item biodegradable.

The top sheet include helps speed the process of absorption, and the thick materials under this layer assist with keeping fluid from spilling back out of the diaper and onto the skin. While the SAPs and cellulose mash are the essential absorbency feature in diapers, driving expendable diapers have been planned with a scope of layers and elements that add to further developed solidness and retention. These parts help forestall rewetting of the touchy skin in the diaper locale and assist with keeping up with legitimate skin wellbeing.

2.3.1. DESIGN OF DIAPER

This creation is intended to be worn on the body having a contractable part which adjusts to the shapes of the body and allows development of the body while staying connected with the body movement. The dispensable diaper has vital flexibly contractible leg openings having a side fold which is of the essential width and adaptability to furnish proceeded with non-slipping contact with the wearer's body, along these lines giving further developed regulation. Batching of the spongy body in the groin region is impeded. The unconstrained development of baby was seen in 4 conditions: stripped, type A, B, C diapers. The speed of lower appendage developments in the Naked condition were higher than when wearing normal diapers. The outcome shows the correlation between knee development, distance

between knees, scope of lifting development. This review inspected the attributes of youthful newborn children's lower appendage unconstrained developments dependent on contrasts in state of diapers.

2.4 ANTIBACTERIAL FINISH

Deepali Mor [9] referenced the finishes given to diapers. Diapers are made from either like cotton, wool, bamboo, jute, cloth, etc., or artificially prepared fibers, for example, nonwoven polypropylene, polyethylene, polyester, nylon, and so forth. Curcumin and Neem powder are the best antimicrobial specialists as they show the antimicrobial action as well as the antiviral, mitigating activity on dermatitis and other skin illness. These are cost effective when contrasted with Zinc oxide and Silver and acquired from sustainable sources i.e., plants and trees. *Cocos nucifera* has a huge inhibitory activity against normal microbes, showing the presence of exceptionally powerful antimicrobial mixtures. *Cocos nucifera* has a critical inhibitory activity against microorganisms, demonstrating the presence of profoundly viable antimicrobial mixtures. It goes about as antifungal and antimicrobial properties. The noticed low MIC and MBC esteems against these microscopic organisms implies that the plant can successfully treat any diseases related with these bacterial microbes. Our review has affirmed the gainful impacts of *Cocos nucifera* husk, with a high antimicrobial impact.

2.5 SUPER ABSORBENT POLYMER

The properties of superabsorbent polymer [10] was studied. The superabsorbent polymer particles were mixed with starch suspension using 0.002-0.20 g of starch per g of SAP. The resulting mixture was then dried at temperature of 150°C.

The absorption properties such as Free Swell Capacity (FSC) and Absorption under Pressure (AUP) of treated SAP were determined at different starch loading using test solution of varying sodium chloride concentrations and compared with the untreated SAP.

Increased gel strength leads to an improved application of SAP in hygienic products, i.e., better flow rate and liquid distribution within absorbent core. Besides having higher permeability, surface crosslinking improves the absorption under pressure of the SAP. Permeability is a property of porous materials that quantifies the relative ease with which a transporting substance can pass through the material. It showed that corn starch has more porous structure, hence has quick liquid flow rate.

2.6 BACKSHEET

Poly lactic acid (PLA) [10] has low weight, and they are recyclable, sustainable, and have high strength and firmness and cause no skin aggravations. Polylactide polymers are firm and weak materials, and it is along these lines important to utilize plasticizers to work on the lengthening and effect properties. The polylactide is completely bio-degradable.

3. MATERIALS AND METHADODOLOGY

3.1 FLOW PROCESS

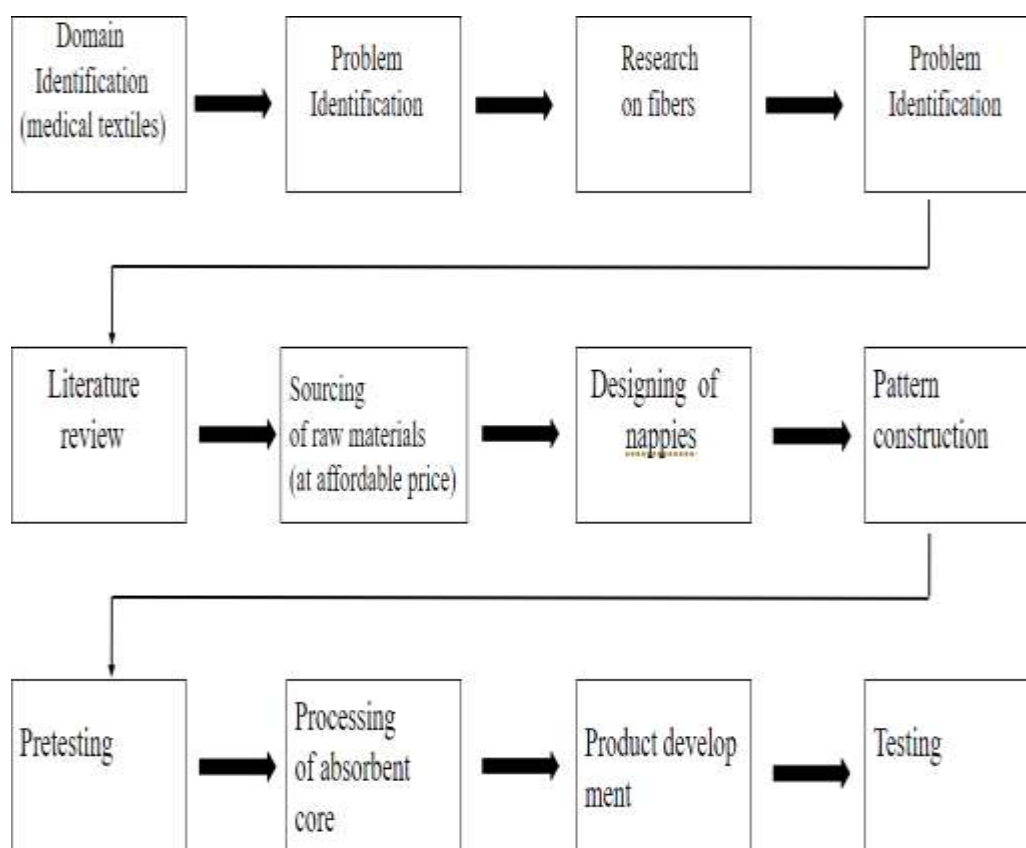


Fig 3.1: FLOW PROCESS

3.2 MATERIALS

3.2.1 TOP SHEET

The top sheet acts as a one-way street for urine. A child pees into the diaper with enough force to send the liquid through that top layer, but a repellent material stops it from running back onto the skin. Instead, the urine sinks deeper into the surge layer, which is designed to take a localized stream and distribute it throughout the absorbent core. If the design did not have this feature, the liquid would saturate on one spot and the rest of the diaper would be useless.

The top-sheet, in proximity to the baby's skin, is made of permeable non-woven polypropylene fabric. A typical top sheet is made from spun or thermo bonding technique and its weight vary between 15 and 20 mg per square meters. The top sheet used in this article has GSM in the range of 40 to 60 (fig 3.1). This layer of the diaper allows the baby's urine to pass through and into the further layers below.

The upper layer is provided by a film material having apertures which are provided to facilitate liquid transport from the wearer facing surface towards the absorbent structure. The main function of top layer is to transfer the liquid to subsequent layers.



Fig 3.2.1: Top sheet

3.2.2.1 BAMBOO FIBRE

Bamboo fibers have excellent wet permeability, moisture vapor transmission properties, soft hand, better drapery. The bamboo fibre is exceptionally soft, light, silky, and its cross-section is filled with several micro-gaps and micro-holes which makes it breathable and cool to wear.

3.2.2.2 CARDING OF BAMBOO FIBRE

Bamboo fiber can be processed handled and framed into a nonwoven web or air blown and utilized as fiber fill in articles like sheet material, stitching, pads, blankets, covers, home outfitting. The bamboo fiber is derived from the mash of the bamboo plants. The bamboo plant is naturally anti-bacterial and possesses deodorizing abilities as well. The bamboo fiber holds these attributes, and in this manner, the strands require no extra assembling cycles or medicines to display Such characteristics. As an additional advantage, the bamboo plant can be developed without the requirement for naturally hurtful pesticides or manures.

These credits settle on bamboo fibre fill a remarkable decision for family articles in an inexorably climate count cognizant buyer market.

Carding is a method of separating the small bamboo tufts into individual bamboo fibers, and it begins the process of parallelization, thereby delivering the fibres in the form of a web. The bamboo filaments are isolated and arranged by the mechanical interaction of two opposing Surfaces. The bamboo filaments can be held by one surface while the other surface brushes the strands causing individual fiber division. The card machine has an enormous turning metallic chamber arranged in the focal point of the machine.

The card clothing comprised needles, wires, fine metallic teeth, or the like installed in a substantial material or in a metallic establishment. The revolution chamber can additionally, be part of the way encompassed by a belt of countless pads situated along the highest point of the chamber, or by a get together of substituting specialist roll and stripper rolls. The bamboo strands, in the wake of being taken care of by a chute or hopper, can be condense into the type of a lap or batting. In this embodiment, the strands leave the chute as a consolidated lap and enter a feed roll. The bamboo fiber lap can then at first be opened into little tufts by a licker-in, which takes care of the filaments to the pivoting chamber the needles of the two contradicting Surfaces of the turning chamber and the specialist and stripper rolls are arranged at a slope in inverse ways and move at various speed. The turning chamber moves quicker than the specialist and stripper rolls. Because of the restricting needle directions and the distinction in speeds between the rolls, the bamboo fiber bunches are pulled and prodded separated. The partition happens between the specialist roll and the turning chamber, while the stripping roll strips the bigger bamboo tufts and stores them back on the pivoting chamber. The filaments can be adjusted in the machine heading and structure an intelligent web underneath the outer layer of the needles of the turning chamber. The recently framed web can be taken out from the outer layer of turning chamber by a doffer roll and saved onto a moving

belt. In a commendable encapsulation, the direction proportion of the bamboo fiber web at the doffer roll can be around 5:1 for the checking machine.

3.2.2.3 SODIUM POLYACRYLATE – SAP

Sodium polyacrylate is considered as a thickening specialist since it increases the viscosity of water-based compounds. In diapers, sodium polyacrylate absorbs water found in urine to build the ability to store fluid and to diminish rashes. Fig 3.2 shows the picture of sodium polyacrylate. Every polymer has hydrophilic electronegative carboxyl side gatherings which hold polar water atoms and swell when hydrated. Thickness of sodium polyacrylate is 1.22 g/3. Every diaper has equitably spread sodium polyacrylate on the web structure. 10 grams of sodium polyacrylate very retentive polymer is spread on the bamboo web structure.



Fig 3.2: SAP

3.2.2.4 BIOPLASTIC

The back sheet is made from a film built from a liquid repellent material. This is additionally called airtight layer. Bioplastic fills in as a watertight base layer that is a manageable, biodegradable, and compostable option in contrast to plastic.

The back sheet is breathable and cooling specialist, to permit dampness to pass. After adjusting the layers in like manner, all sides of the diaper were fixed by hot dissolve cement. Fig 3.3

shows the picture of bio-plastic sheet having GSM of 30. The third most customer item is dispensable diaper representing 3.4 million tons of waste per annum in US [22]. It takes approximately 500 years to decompose in absence of sunlight and O_2 and 100 years in presence of sunlight.



Fig 3.3: Bioplastic

3.2.2.5 COCONUT HUSK FINISH

Hygienic products require anti-bacterial finish for preventing germ deposition on skin. If the top layer of diaper in vicinity to skin is wet, there happens bacterial movement which affects the skin and causes rashes. To control the bacterial movement, the top layer ought to be treated anti-bacterial finish which destroy or suppress the growth of microorganisms and their negative effects of Odor, staining and deterioration.. In this diaper, coconut husk finish is imparted. It has charming smell, makes the wearer cool. It has normal detoxifying specialist.



Fig 3.4: Coconut husk powder

3.2.2.6 DOUBLE SIDE TISSUE TAPE

Tissue tape is a special tape that comprises of non-woven tissue and is covered with solid glue on the two sides. It bonds solidly to comparable or disparate materials. High-Shear cement on the two sides. Solid cement, Bonds well to any surface Widely utilized by printers, crafters, and a lot more utilities. Advantageous to utilize simple to tear. Unique defined cement gives solid holding power and no cement weakening. Phenomenal temperature and dissolvable opposition. Great shear strength, the cement strength is not really impacted with temperature change and long stockpiling. No slippage even later an extensive stretch of use. This tape is of 1" width. (Fig 3.5) The thickness of tissue tape is 24 mm. It is fixed on the posterior of bio-plastic waterproof layer. It is fixed upward in three lines separating 6 mm between. This obsession shows in much the same way as sterile napkin work. This solid cement fixes on both bio- plastic external layer and underwear single shirt texture well.



Fig 3.5: Double side tissue tape

3.2.2.7 WET WIPES

Wet wipes are used for cleaning purposes like personal hygiene. Wet wipes are produced from nonwoven fabrics made of polyester or polypropylene. The material is moistened with water or other liquids. Fig 3.6 shows the wet wipes.



Fig 3.6: wet wipes.

3.3 DESIGN OF DIAPER

These are formed more like disposables, with a restricted groin and wide wings that fold over a child's abdomen. Some require diaper clasp, yet others are secured with Velcro. Some fitted diapers have versatile at the abdomen and legs, and a more spongy layer in the middle.

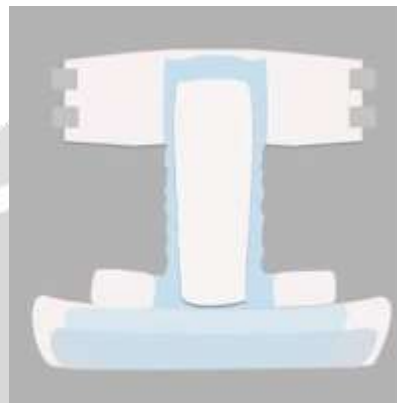


Fig 3.7: Design of nappy.

3.3.1. MEASUREMENT CHART

Size	Waist circumference (in inches)	Rise (in inches)
S	36	19
M	40	20
L	44	21.5

Table 3.1: Measurement chart

4 .TESTING METHODS

Testing	Standard
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Water absorbency test for (Sodium polyacrylate)	ISO 20158-2018
Water absorbency test for (bamboo fibre)	ISO 20158-2018
Ph test (web form of bamboo with sodium polyacrylate)	ISO 3071 – 2020

Table 3.2: Testing methods

5. CONCLUSION

The article is based on design and development travel nappies with wipes. The approach consists of 1. To design and develop pattern of Nappies. 2. To use bamboo fibre in the absorbent layer and bioplastic as waterproof layer. 3. To impart Cocos nucifera husk antibacterial, antifungal finish to top sheet. 4. To impart wet wipes to nappies. From the literature reviews, case study this article is concluded that it accounts for minimalization. It also accounts for the versatility; The design of nappies helps travelers, does not need to undress completely to wear the nappies. Imparting of wipes helps the traveler wipe of the remains and dispose of the nappies easier.

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