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"Ecosoft: Sustainability Baby Diapers With Water Hyacinth Fiber, Bamboo Fiber, Centre Core Layer Sugar Cane Charcoal, And Cotton Fiber"

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ABSTRACT:

This project focuses on the development of Eco-Soft, a sustainable and biodegradable baby diaper designed using natural materials to reduce environmental impact. The diaper features a multi-layer construction with a core made from a blend of water hyacinth fiber and bamboo fiber, which are known for their absorbent properties and biodegradability. The center layer incorporates sugar cane charcoal, enhancing absorbency and odor control, while the outer layer is made from cotton, ensuring comfort and softness for the baby's skin. The study evaluates the performance, comfort, absorbency, and biodegradability of the diaper, comparing it to conventional disposable diapers. The results indicate that Eco-Soft offers an eco-friendly alternative without compromising on performance, comfort, or safety. The diaper's biodegradability significantly reduces its environmental footprint, making it a promising solution for sustainable baby care products. This research presents the potential of using natural fibers and renewable materials to create products that are both functional and environmentally responsible.

KEY WORD: EcoSoft, Sustainable Baby Diapers, Water Hyacinth Fiber, Bamboo Fiber, Sugar Cane Charcoal, Cotton, Biodegradable, Eco-Friendly, Absorbency, Odor Control, Environmental Impact, Renewable Materials, Sustainable Baby Care.

OBJECTIVES

1. To Develop a Sustainable Diaper
2. To Improve Absorbency and Comfort
3. To Promote Biodegradability
4. To Compare Environmental Impact
5. To Explore Alternative Materials in Diaper Manufacturing
6. To Promote Sustainable Consumer Choices

INTRODUCTION:

The environmental impact of disposable diapers has become a significant concern due to their non-biodegradable nature and the waste they contribute to landfills. Conventional diapers, made primarily from synthetic materials, take hundreds of years to decompose, creating a long-lasting burden on the environment. In response to this issue, there is a growing demand for sustainable alternatives that offer the same functionality while being environmentally responsible.

This project focuses on the development of EcoSoft, an eco-friendly baby diaper designed with sustainability in mind. The diaper is constructed using natural, renewable materials such as water hyacinth fiber, bamboo fiber, sugar cane charcoal, and cotton, all of which offer various benefits in terms of absorbency, biodegradability, and comfort. The core layers are made from a blend of water hyacinth and bamboo fibers, which are known for their natural absorbent properties and minimal environmental impact. The center layer incorporates sugar cane charcoal, which not only enhances absorbency but also helps to control odors. The outer layer is made of cotton, offering a soft and breathable surface that is gentle on a baby's sensitive skin.

This project aims to evaluate the performance, comfort, absorbency, and biodegradability of the EcoSoft diaper, comparing its effectiveness with traditional disposable diapers. By utilizing these sustainable materials, EcoSoft seeks to offer an alternative that significantly reduces the environmental footprint associated with baby care products. The goal is to provide parents with an eco-friendly diaper that is functional, safe, and comfortable for their babies, while contributing to a more sustainable future.

In the following sections, the methodology, testing, and results will demonstrate how the combination of these natural materials can transform the diaper industry and provide a cleaner, greener alternative to conventional disposable products

Properties:

- High Absorbency
- Free Swell Absorptive
- Ph Values
- Soft and Gentle on Skin
- Odor Control
- Lightweight and Flexible

Methodology:

1. Material Selection:

a) Core Layer (Water Hyacinth Fiber & Bamboo Fiber):

- **Water Hyacinth Fiber** is chosen for its biodegradability, strength, and absorbency. It is also a sustainable material, often considered a weed that negatively affects aquatic ecosystems. By repurposing this fiber, it helps to combat environmental pollution.
- **Bamboo Fiber** is selected for its antibacterial properties, softness, and sustainability. Bamboo grows quickly, requires minima…
- **Sugar Cane Charcoal** is used in the center layer due to its excellent moisture-absorbing capacity and its natural ability to reduce odors. Charcoal from sugar cane is a renewable resource that can be used

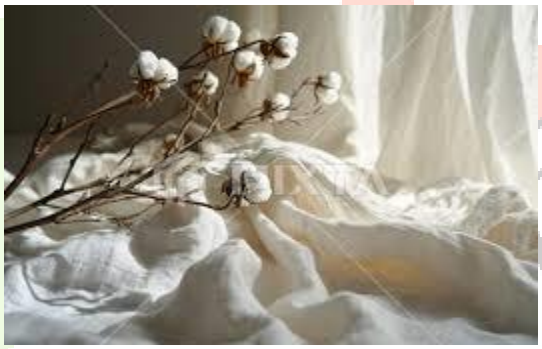
without harming the environment, making it a sustainable alternative to chemical-based additives in conventional diapers.

(i)Water hyacinth fiber

(ii)Sugarcane charcoal (iii)bamboo fiber-

b) Outer Layer (Cotton):

The outer layer is made of Cotton, which is known for being breathable, soft, and gentle on the skin. It is a natural fiber that is widely available and widely used for its comfort and hypoallergenic properties, ensuring the baby's skin stays irritation-free.



Cotton fabric

2. Design and Manufacturing:

The diaper is designed with a multi-layer structure to ensure maximum performance:

- Top Layer: Soft cotton material to provide comfort and prevent skin irritation.
- Core layer: a bland of water hyacinth fiber and bamboo fiber ensuring absorbency and natural antibacterial properties
- Center layer: sugarcane charcoal to provide additional absorbency , moisture control and odor management
- Bottom layer: soft cotton for durability and leak protection while maintaining a breathable environment for the baby.

The design aims to ensure optimal absorbency, comfort, leak prevention, and a high level of biodegradability.

3. Testing:

PH Testing and Free Swell Absorptive Testing for EcoSoft: Sustainable Baby Diapers

3.1. Free Swell Absorptive Testing:

- The Free Swell Absorbency test measures the diaper's ability to absorb liquid (typically water or a synthetic urine solution) under specific conditions. This test evaluates the absorbent properties of the diaper's core, particularly the combination of water hyacinth fiber, bamboo fiber, and sugar cane charcoal in the core layer.
- Sample Preparation: A standardized weight of the diaper's core layer (including the water hyacinth fiber and bamboo fiber) is isolated, and the sugar cane charcoal component is also included in the sample for testing.

3.2. PH Testing:

- The pH testing is conducted to ensure that the materials used in the EcoSoft diapers are safe and non-irritating for the sensitive skin of babies. It helps verify that the diaper's composition, especially the core and absorbent layers, maintains a skin-friendly pH balance.
- Sample Preparation: Small pieces of the diaper, including the outer cotton layer and the absorbent core (comprising water hyacinth fiber, bamboo fiber, and sugar cane charcoal), are selected for testing.

4.Environmental Impact Assessment:

- Life Cycle Assessment (LCA): An LCA is performed to analyze the environmental impact of the EcoSoft diaper throughout its production, use, and disposal phases. This includes evaluating raw material sourcing, manufacturing energy usage, and waste generation.
- Comparative Analysis: The EcoSoft diaper is compared with standard disposable diapers in terms of carbon footprint, water usage, and waste generation. The goal is to demonstrate that the diaper's production and disposal have a significantly lower environmental impact.

5. Comparison with Conventional Diapers:

A comparative analysis is conducted between EcoSoft diapers and conventional disposable diapers in terms of absorbency, comfort, biodegradability, and overall environmental impact (carbon footprint, water usage, etc.).

6. Cost Analysis:

A cost analysis is conducted to evaluate the feasibility of producing EcoSoft on a large scale. This includes examining the material costs, production costs, and potential for market adoption. It also assesses the product's pricing in comparison to conventional disposable diapers.

Procedure:

1 Material Selection and Preparation:

- Water Hyacinth Fiber:
  - Collect and process water hyacinth plants from water bodies.
  - Clean and dry the fiber to remove impurities.
  - Process into a soft, absorbent material suitable for the diaper core.
- Bamboo Fiber:
  - Harvest bamboo and extract the fiber using an eco-friendly chemical process.
  - Treat the bamboo fibers to soften them and enhance absorbency.
- Sugar Cane Charcoal:
  - Prepare sugar cane from agricultural waste and convert it into charcoal using a sustainable charcoal-making process.
  - Charcoal is processed into small particles and blended to ensure odor control and moisture retention properties.
- Cotton:
  - Use organic cotton for the outer layer of the diaper to ensure softness and comfort. - The cotton is cleaned, spun, and processed into fabric suitable for baby products.

2 Diaper Design and Layer Construction:

Layer Structure

a) Core Layer:

- Blend water hyacinth fiber and bamboo fiber to create the absorbent core of the diaper. The fibers are processed to be soft and highly absorbent.
- Form the fibers into a sheet or mat-like structure to form the diaper's core layer.

b) Center Layer:

- Integrate sugar cane charcoal into the center layer of the diaper. This layer serves to control odors and enhance moisture retention. The charcoal is blended into the fiber mix to create a functional absorbent layer.
- Outer Layer:
- Prepare the cotton fabric for the outer layer, which serves to provide comfort and ensure the diaper is gentle on the baby's skin.
- The cotton is soft, breathable, and natural to avoid irritation.

3 Diaper Assembly:

- Layer Assembly:
  - Assemble the three layers of the diaper (core, center, and outer) into a single unit.
  - The absorbent core (water hyacinth and bamboo fiber) is placed in the middle, followed by the sugar cane charcoal-enhanced layer.
  - The cotton fabric is attached to the outer layer, providing softness and comfort for the baby's skin.
- Shape and Size Cutting:
  - Cut the layered fabric to the desired diaper shape and size, ensuring it fits a range of baby sizes.
  - The edges of the diaper are secured using heat bonding or stitching, depending on the material's nature.

4 Testing and Evaluation.

- Free Swell Absorptive Testing:
    - The Free Swell Absorbency test measures the diaper's ability to absorb liquid (typically water or a synthetic urine solution) under specific conditions. This test evaluates the absorbent properties of the diaper's core, particularly the combination of water hyacinth fiber, bamboo fiber, and sugar cane charcoal in the core layer.
    - Sample Preparation: A standardized weight of the diaper's core layer (including the water hyacinth fiber and bamboo fiber) is isolated, and the sugar cane charcoal component is also included in the sample for testing.
- PH Testing and Free Swell Absorptive Testing for EcoSoft: Sustainable Baby Diapers
- PH Testing:
    - The pH testing is conducted to ensure that the materials used in the EcoSoft diapers are safe and non-irritating for the sensitive skin of babies. It helps verify that the diaper's composition, especially the core and absorbent layers, maintains a skin-friendly pH balance.
    - Sample Preparation: Small pieces of the diaper, including the outer cotton layer and the absorbent core (comprising water hyacinth fiber, bamboo fiber, and sugar cane charcoal), are selected for testing.
- Comfort Test:
    - Perform sensory tests on the cotton outer layer for softness, ensuring it is gentle on the baby's skin.
    - Evaluate flexibility and breathability to avoid discomfort or skin irritation.

5 Environmental Impact Assessment:

- Life Cycle Assessment (LCA):
- Perform an LCA to evaluate the overall environmental impact of the EcoSoft diaper from material sourcing to disposal.
- Assess the carbon footprint, water usage, and waste generation associated with the production, use, and disposal of the diaper.
- Comparative Analysis:
- Compare the environmental impact of EcoSoft with standard disposable diapers to assess improvements in sustainability, including reductions in carbon footprint, energy consumption, and landfill waste.

6. Final Product Evaluation and Packaging:

- Final Evaluation:

- After testing, perform a quality check on the final diaper product for performance, absorbency, comfort, and overall suitability for babies.
- Packaging:
    - Design eco-friendly packaging for EcoSoft diapers using recyclable materials to further reduce the product's overall environmental impact.
- Marketing and Distribution:
    - Prepare the diapers for commercial distribution, ensuring that all product information highlights the eco-friendly and sustainable features of EcoSoft.

Test report:

- Free swell absorptive capacity
- PH test

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KSR College Of Arts And Science For Women, Ref : Letter Dt.04.02.2025

(Sample Tested at : R.H.65% +/- 2% and Temp. 21 Degree C +/- 1 Degree C)

Free Swell Absorptive Capacity.** ***NWSP 240.0.R2 (15)***	**P2401402-1** Described by the Customer : **Water Hyacinth and Charcoal Core Layer**
Type of test fluid used	Saline solution
Concentration of Sodium chloride	0.9% by mass
Free Swell absorptive capacity in g/g	
Specimen -1	18.5496
Specimen -2	20.1941
Specimen -3	17.2610
Specimen -4	18.0923
Specimen -5	18.3337
Average free swell absorptive capacity in g/g	18.4862

*** Test(s) not covered under NABL Scope.*

- End of Report -

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pH Values *IS 1390:2022*	**S2400443-1** **Water Hyacinth and Charcoal**
Mean pH Value	6.15
pH of extracting solution	5.67
Temperature of the extracting solution	31.1°C.

Standard : IS 1390 : 2022 Test Solution Used : 0.1 M Potassium Chloride Solution.

This is a computer generated report, hence does not require signature.

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CONCULUTION:

EcoSoft: Sustainable Baby Diapers provide an eco-friendly alternative to traditional disposable diapers by using natural, biodegradable materials like water hyacinth fiber, bamboo fiber, sugar cane charcoal, and cotton. These materials offer excellent absorbency, odor control, and comfort, ensuring that babies remain dry and comfortable without compromising on environmental impact. The diaper's biodegradability reduces landfill waste, and its lower carbon footprint, when compared to conventional diapers, makes it a promising sustainable choice. EcoSoft demonstrates that innovative, eco-conscious design can successfully meet both performance and sustainability goals, paving the way for a more environmentally responsible future in baby care products.

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