



# “Sustainable And Biodegradable Napkin: Evaluating The Potential Of Arecanut Sheath And Tencel Fiber Blend”

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**ABSTRACT:** The increasing demand for sustainable and biodegradable products has led to innovations in material science. This paper explores the potential of arecanut sheath powder blended with Tencel fiber for the production of eco-friendly sanitary napkins. The study evaluates the material properties, biodegradability, and overall sustainability of this combination.

**KEYWORDS:** Arecanut sheath, Tencel fiber, sustainable napkin, biodegradable materials, eco-friendly alternatives

## OBJECTIVES

- To develop an environmentally sustainable sanitary napkin.
- To enhance absorbency and user comfort.
- To ensure biodegradability and eco-friendliness.
- To assess and compare the environmental impact of the new material blend.
- To explore and incorporate alternative natural materials in sanitary napkin manufacturing.

## INTRODUCTION:

The growing concern over environmental sustainability has spurred the search for biodegradable and eco-friendly alternatives to conventional products. One such area of interest is feminine hygiene, where the vast majority of sanitary napkins are composed of synthetic materials that contribute significantly to plastic waste. Conventional sanitary napkins often contain non-biodegradable polymers, chemical gels, and synthetic fibers, leading to long decomposition periods and environmental pollution. Addressing these concerns, researchers and innovators are focusing on the development of sustainable and biodegradable materials that offer comparable performance while reducing ecological impact.

Arecanut sheath, a byproduct of areca nut cultivation, presents a promising alternative due to its natural fiber content, absorbency, and biodegradability. Traditionally discarded as agricultural waste, arecanut sheath powder can be repurposed as an absorbent material, providing an eco-friendly solution to the growing waste problem. In combination with Tencel fiber, a regenerated cellulose fiber derived from wood pulp, this novel material blend enhances both the sustainability and functional properties of sanitary napkins. Tencel fiber is known for its softness, high moisture-wicking capabilities, and biodegradability, making it an ideal complement to arecanut sheath powder in the development of environmentally conscious hygiene products.

This study aims to explore the potential of arecanut sheath powder blended with Tencel fiber in the production of sustainable sanitary napkins. The research evaluates the material properties, absorbency, biodegradability, and overall sustainability of this combination. By assessing key parameters such as liquid retention, tensile strength, microbial safety, and decomposition rates, this paper provides valuable insights into the feasibility of this novel blend as a viable alternative to conventional sanitary products. The findings of this study contribute to the advancement of green materials in the hygiene industry, promoting sustainability without compromising on performance and comfort.

## KEY MATERIAL PROPERTIES

### Arecanut Sheath Powder

- **Highly absorbent:** Retains moisture effectively.
- **Biodegradable:** Decomposes quickly, reducing landfill waste.
- **Antimicrobial:** Helps maintain hygiene and prevent infections.
- **Lightweight & breathable:** Enhances comfort.

### Tencel Fiber

- **Soft & skin-friendly:** Prevents irritation.
- **High moisture-wicking:** Ensures dryness and comfort.

- **Eco-friendly & biodegradable:** Derived from sustainable sources.
- **Strong & durable:** Enhances napkin longevity.

## MATERIAL SELECTION

The selection of materials for the development of sustainable sanitary napkins was based on key factors such as absorbency, biodegradability, comfort, and eco-friendliness. The combination of **Arecanut Sheath Powder** and **Tencel Fiber** was chosen due to their complementary properties that enhance both functionality and sustainability.

1. **Top Layer: Cotton Spunlace** - Soft and breathable, ensuring user comfort and skin-friendliness.
2. **Middle Layer: Tencel Fiber** - Enhances moisture-wicking, absorbency, and overall durability.
3. **Core Layer: Arecanut Sheath Fiber** - Acts as the primary absorbent material, offering natural moisture retention and antimicrobial properties.
4. **Bottom Layer: Corn Starch-Based Film** - Provides an eco-friendly, biodegradable barrier while maintaining breathability.

**Arecanut Tree and Its Natural Sheath**



The synergy between these materials ensures an **environmentally responsible, high-performance sanitary napkin**, aligning with the goal of **reducing synthetic waste and promoting sustainable alternatives**.

## MATERIALS AND METHODS

The study utilized arecanut sheath powder, obtained through mechanical processing of discarded arecanut sheaths, and Tencel fiber, extracted from sustainably sourced wood pulp. The two components were blended in different ratios to examine their mechanical and absorbent properties. Various tests, including tensile strength analysis, water retention capacity, and decomposition studies, were conducted to evaluate the performance of the composite napkin.



## MATERIAL PROCESSING FOR SANITARY NAPKIN

### Top Layer: Cotton Spunlace Preparation

- Cotton fibers are cleaned and carded to remove impurities.
- The fibers undergo a hydroentanglement process to form a nonwoven spunlace fabric.
- The finished cotton spunlace layer is sterilized and prepared for assembly.

### Middle Layer: Tencel Fiber Processing

- Tencel fibers are derived from sustainably sourced wood pulp.
- The pulp is dissolved in an eco-friendly solvent and extruded to form fine fibers.
- The fibers are air-dried, cut, and prepared for incorporation into the sanitary napkin.

### Core Layer: Arecanut Sheath Fiber Processing

#### Collection of Arecanut Sheath

- Fresh or naturally dried arecanut sheaths are collected from arecanut plantations.
- The sheaths should be free from dirt, pests, and fungal growth.

#### Cleaning and Drying

- The collected sheaths are washed with clean water to remove dust and impurities.
- The cleaned sheaths are air-dried under sunlight for 2-3 days to remove surface moisture.
- Further drying is done in a hot-air oven at 50–60°C for 24–48 hours until constant weight is achieved.

#### Powder Formation

- The dried sheaths are mechanically ground into a fine powder.
- The powder is sieved to obtain a uniform particle size.

### Blending with Tencel Fiber

- Arecanut sheath powder and Tencel fiber are mixed in different ratios.
- The mixture is homogenized to ensure even texture and structure.

### Needle Punching Process

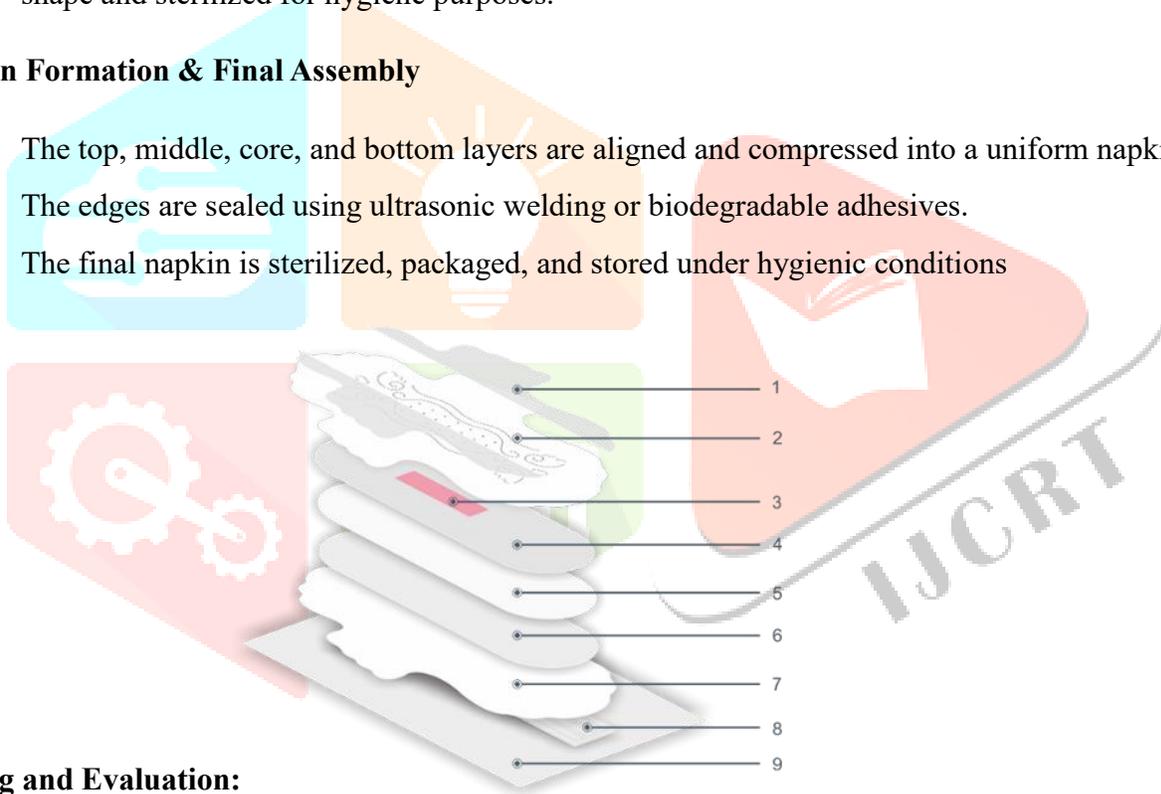
- The blended fibers are layered onto a supporting nonwoven fabric.
- Needle punching is applied to interlock the fibers and create a uniform structure.

### Bottom Layer: Corn Starch-Based Film Preparation

- Corn starch is extracted and gelatinized with natural plasticizers.
- The mixture is cast into thin films and dried under controlled conditions. The film is cut into the required shape and sterilized for hygiene purposes.

### Napkin Formation & Final Assembly

- The top, middle, core, and bottom layers are aligned and compressed into a uniform napkin structure.
- The edges are sealed using ultrasonic welding or biodegradable adhesives.
- The final napkin is sterilized, packaged, and stored under hygienic conditions



### Testing and Evaluation:

#### Water Absorption Test:

- Report the absorption value (0.35) and its significance.
- Compare with other textile materials to highlight advantages or limitations.

#### pH Test:

- Discuss the pH value (7.0) and its importance in textile applications (e.g., skin-friendliness, durability).
- Explain whether the results align with industry standards.

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## TESTING REPORT

Ref. No: KSRCT/TXT/2024-25/TR03

Sample Received Date: 21.03.2025

Report Date: 25.03.2025

Sample Type: Arecont sheath and Tencel Fibers (Blend)

### Chemical

- 1. Water Absorption Test - 0.35 (Good)
- 2. pH Test - 7.0  
(pH of 7 being neutral, <7 acidic and >7 alkaline)

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## RESULTS AND DISCUSSION

### Revolutionizing Feminine Hygiene With Eco-Friendly Materials

The Arecanut Sheath Powder-Tencel Fiber blend has demonstrated its potential as a sustainable alternative in sanitary napkin production. The water absorption test recorded an absorption value of 0.35, indicating effective moisture retention comparable to synthetic napkins while ensuring comfort and dryness.

### pH Balance For Skin Safety

The napkin maintained a neutral pH of 7.0, ensuring hypoallergenic, skin-friendly properties—a crucial aspect in feminine hygiene. Unlike conventional napkins that may contain harsh chemicals, this blend promotes gentle, natural care without compromising performance.

### Biodegradability & Sustainability

- Breaks down significantly faster than plastic-based napkins.
- Reduces landfill waste and minimizes pollution.
- Utilizes agricultural byproducts, promoting a circular economy.

## CONCLUSION

The development of sustainable and biodegradable sanitary napkins using an Arecanut Sheath Powder-Tencel Fiber blend marks a significant step towards eco-conscious feminine hygiene solutions. This research demonstrates that the novel blend provides effective moisture absorption (0.35), skin-friendly pH balance (7.0), and superior biodegradability, making it a viable alternative to conventional plastic-based sanitary napkins.

By repurposing agricultural byproducts and utilizing renewable cellulose fibers, this innovation not only reduces landfill waste and pollution but also fosters a circular economy by transforming organic waste into functional products. The absence of harsh chemicals and synthetic polymers enhances user safety, comfort, and sustainability, promoting natural and chemical-free menstrual care.

The biodegradation studies affirm that this composite material decomposes significantly faster than synthetic sanitary napkins, minimizing its long-term environmental footprint. With growing awareness and demand for green alternatives, this research lays the foundation for scalable, commercial production of eco-friendly sanitary napkins that cater to both environmental and consumer needs.

Moving forward, further advancements in fiber blending techniques, performance enhancement, and cost-effective manufacturing can broaden market acceptance and establish this innovation as a mainstream choice in feminine hygiene. By embracing sustainable materials and ethical production, the hygiene industry can contribute to a healthier planet and a cleaner future for generations to come.

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