DEVELOPMENT OF PAPER AND INVITATION CARDS USING ARECA NUT HUSK FIBERS

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Abstract – Areca nut crop grown high in quantity in India compared to other country which is highly profitable. These areca nut are high marketable colony crops. States like Karnataka(40%), Kerala (25%), Assam (20%),Tamil Nadu , Meghalaya and West Bengal together makes 15%. Natural fibers can play an important role in renewable, biodegradable and eco-friendly properties. The characteristics of plant vary according to various climatic conditions under which plant matures and chemical composition like cellulose, hemicelluloses , lignin ,waxes and resoluble substances with other biomolecules. Areca nut husk fiber is an agriculture waste which do not add any economy of areca plantation which is being wasted in large quantity from agriculture fields as well as tobacco industries. The present work focuses on extraction of areca husk fibers available in and around Davangere district, chemical treatment and conversion of fibers into pulp and addition on natural colors which presents solid waste management as ideal for development of naturally colored papers and invitation cards. The design and development was done in collaboration with Grasim industries private limited, Harihara of Davangere district.

Key Words : Areca nut husk fibers, agro solid waste management, eco-friendly, cost effective, invitation cards.

INTRODUCTION

Arecanut (*Areca catechu L.*) is a highly materialistic crop widely cultivated for commercial purposes. Its crucial to understand and implement effective practices in Arecanut gardens to have more income. The minimum of Arecanut gardens yield around 5.5-6 tons of organic waste per hectare annually. However, directly recycling this waste may not meet the crop's immediate demands where in Karnataka 1.53 lakh hectar of arecanut has been growing. Generally bamboo ,eucalyptus and subabul trees are extensively used for making of paper and invitation cards for which large mass of trees are cut down. The production of these paper and invitation cards using wood pulp have significant environmental impacts like deforestation loss of biodiversity, and increase of green house gases.

Where as agro waste is major waste which is produced whole from agricultural operation from growing crops or animals, some examples like fruit bearing trees, vegetable, banana plant stem, areca nut husk. Some agro waste can be easily decoposed and used as manure but, some take time to decompose like areca nut husk which have no value at present, we can take opportunity give a value addition and eco-friendly product .

Arecanut waste disposal has become a major problem in Arecanut growing areas, with burning being the primary disposal method. Unfortunately, this practice results in the loss of valuable staples and nutrients. The capability of Arecanut waste as compost or field incorporation has not wholly utilized in India where people has to still understand the importance of it. Lignin, a significant component in Arecanut fibers, protects cellulose from decomposition. Although most fungi cannot break down lignin, some wood-rotting fungi can degrade lignocellulosic materials. Arecanut fibers are a promising material due to their abundance, affordability, and biodegradability.

As we know that millions of trees are cut down to prepare papers, tissues etc so here we use the biodegradable agro solid waste to prepare invitation cards and papers using natural colour and natural binding agent. As a part of agro waste management, for preparation of invitation cards and papers, which make cards as eco-friendly and cost effective .

2. MATERIALS AND METHODS:

Materials:

Raw areca nut husk, Autoclave digestor, Disintegrator and Bleaching agent (caustic lye, sodium hypochlorite, chlorine dioxide), white liquor, compressor machine, Wooden frame with mesh .

Methods:

Selection and Collection of Natural Fibres

The selection was based on specific criteria: Cost Effectiveness, Ease of Availability, Fibre Composition.

Drying and Separation

The areca husks were subjected to a week-long drying process, after which the fibers were extracted from the shell.

Moisture Testing :Moisture content refers to the amount of water present in a material, expressed as a percentage of the material's total weight.

Moisture content , $C=(W/W+D) * 100$

Chipping

The areca husks were fed into a chipper, resulting in the building of small chips from all three samples (raw form, husk fibers, and shells).

Ash Analysis

An Ash test was conducted to know if the medium contained fillers. The analysis identifies the total filler content but cannot specify individual percentages in multi-filled materials without additional test procedures. These involved taking a accurate weight of the sample and placing it into a dried and pre-weighed porcelain crucible. The sample was burned in atmosphere at temperatures above 600°C. After cooling the crucible to room temperature in a desiccators, the remaining ash residue in the can be considered filler until the residue was less than 1%. Residues of less than 1% were result of additives that did not eliminate . The chips were exposed to a muffle furnace at 730°C for 60 minutes, and the rest over ash was studied for concentrations of iron, calcium, and silica.

Extractive tests

Extractives from the material are commonly obtained using three main methods:

- Acetone Extraction
- Alcohol Extraction
- Water Extraction

Cooking

For all three types of fibers, their respective weights were measured. A total of 112g of fibers (accounting for a 10% correction for moisture) were combined with 390 ml of water inside a bomb and cooked for 90 minutes at 160°C. To facilitate the cooking process and achieve high absorbance, the bath inside the autoclave digester is with Poly Ethylene Glycol (PEG). PEG is used due to its high boiling point of 200-300°C, which makes it suitable for this cooking process, as it softens fibers.

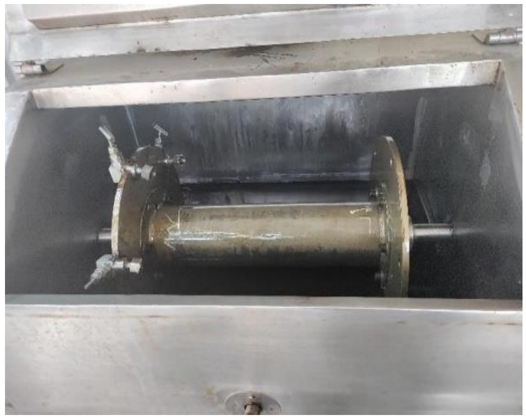

Fig-1: Autoclave digestor for cooking

Draning the pre-Hydrolysis liquor

The Pre-Hydrolysis (PH) liquor refers to the liquid obtained after cooking the fibers using the method described above. This liquor is drained to assess the hemicellulose content. Subsequently, it is transferred to the biogas plant for the production of biogas.

Cooking with White Liquor

Next, the fibers are subjected to cooking with white liquor, which consists of Na_2S, NaOH, and Na_2CO_3. The fibers, along with the white liquor, are placed inside the bomb and kept in the autoclave digester for the duration of 35 minutes.

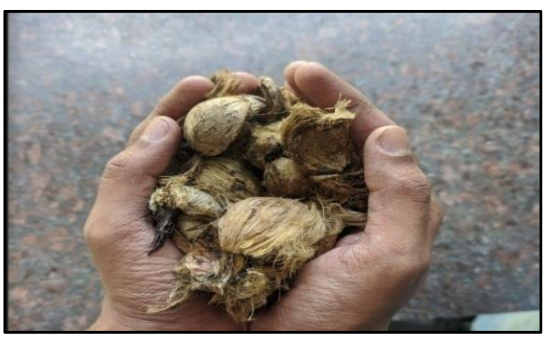

Fig-2: Before cooking

Fig-3: After cooking

Draining Black Liquor

After the cooking process, the resulting black liquor, containing mainly lignin from the fibers, is drained from the bomb. It is then cleared with demineralised water (DM water) and subsequently pumped into a boiler for heating purposes.

Disintegration and Straining

The pulp obtained from the previous steps is loaded into a disintegration jar, where it undergoes disintegration at 5000 rpm for 2 runs. The disintegrated pulp is then strained and washed. The solid material left behind after straining is referred to as unbleached pulp.

Fig-4: Circular disc sheet made from unbleached pulp

Bleaching

The unbleached pulp undergoes a series of bleaching treatments to achieve the desired brightness and purity. Initially, it is treated with H_2SO_4 to reduce the pH to 2.6. Next, the pulp is subjected to bleaching with ClO_2 for 90 minutes at 70°C in a water bath. After bleaching with ClO_2, the pulp is strained and washed using De-Mineralized (DM) water.

Following this, the washed pulp is treated with Caustic Lye (NaOH) for 90 minutes at 70°C in a water bath. After another round of straining and washing, the pulp is further treated with Sodium Hypochlorite (NaClO) for 90 minutes at 70°C in a water bath. Subsequently, the pulp is washed and strained again. Finally, a second treatment with Sodium Hypochlorite at 70°C for 90 minutes in a water bath is performed. Through this bleaching process, the pulp achieves the desired level of brightness and is purified for subsequent uses.

Sheet Making

The bleached pulp is first transformed into a slurry with a pourable consistency. This slurry is then converted into sheets using vacuum chambers. Then added binding substance and natural colours to pulp .With the help of wooden frame with mesh is floated carefully in slurry to have pulp in frame to form of paper. The pulp from frame is taken out carefully on cotton cloth with the help of sponge and roller.

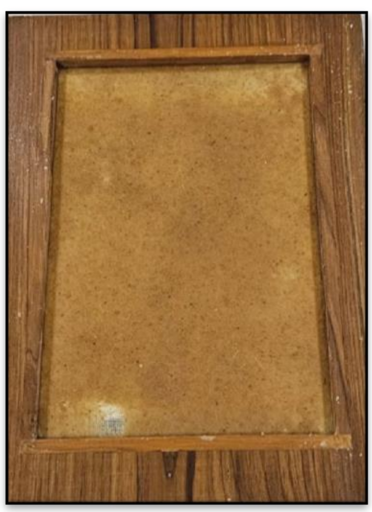

Fig-5: Wet sheet in frame

Compressor:

Using compressor the sheets out of water on the cotton cloth are compressed to drain out the excess water

Drying of sheets

Sheets out of compressor are dryed out in natural light for a week to have stiffness.

Fig-6: Areca nut husk sheet

RESULTS AND DISCUSSION

- The pulp yield from areca husk fiber was determined to be 39%, which is comparable to the yield obtained from Eucalyptus and Bamboo fibers. Grasim industry experts believe that by standardizing the pulp-making process, the yield from areca husk can be further improved.
- The concentration of Calcium and Iron in the samples was measured as 13.5 ml and 0.4 ml, respectively, in 50 ml and 2 ml of the sample.
- The softness, fluffiness, and hardness of the areca husk fiber were found to be comparable to Eucalyptus and Bamboo fibers.
- The areca husk fibers naturally have low brightness and whiteness due to their dark color. Since the sheets made from areca husk they are naturally coloured and can be made to look beautiful and economic which can be replaced by tree pulp to make invetation cards and papers.
- These is the best way to reduce the agro waste which will take at least two years to decompose.

Table-1: Extractive and Inorganic Components

Extractive		
Acetone	**%**	**0.14**
Alcohol	**%**	**0.10**
Water	**%**	**2.62**
Total	**%**	**3.129**
Inorganic Components		
Ash	**%**	**8.92**
Acid Insolubles	**Ppm**	**67436**
Silica	**Ppm**	**6390**

R2O3	**Ppm**	**-**
CaO	**Ppm**	**3654**
Fe	**Ppm**	**2471**

3. CONCLUSION:

- The result in present work have the social and economical benefit by conversion of agro waste which does not have any commercial value .
- The people of rural and remote places will get benefit as we use zero value raw material which would be affordable to all.
- These use areca nut husk will have reduced deforestation as we use lots of trees for raw material creates entrepreneurial opportunities as raw materials required to prepare the products in much cheaper.

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