



Making paper from banana plant bark or banana peel fibres.

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Abstract:

Banana paper is a type of paper created from banana plant bark or banana peel fibers. Banana paper has a lower density, higher stiffness, higher disposability, higher renewability, and higher tensile strength compared to traditional paper. Wrapping paper made from banana stem fiber is produced through various processes. The banana stem fiber is extracted from the pseudo-stem of the banana plant and then blended with other materials such as water, wastepaper, sugarcane bagasse, and nano zinc oxide. The use of banana stem fiber in wrapping paper production not only provides a potential source of non-wood raw material but also contributes to the comprehensive utilization of bananas and reduces production costs.

Keywords: wrapping paper, plant bark, pulp, Banana

Introduction:

In the North Eastern region of India, several varieties of banana trees are found, one of which is genus *Musa*. North Eastern region of India has very suitable weather for banana crops. Genus *Musa* is cultivated in large scale as well as it contains very good percentage of cellulose [1-2]. The earliest evidence of the use of banana stems as a source of fiber dates back to 13th century Japan. However, its popularity declined with the upsurge of silk and cotton fibers imported from China and India [3].

Banana paper was first patented in the United States on March 16, 1912, by Charles M. Taylor and Howard Kay Cook. They both learned that cellulose fiber can be easily removed from the waste of the banana plant, and that the fiber is well adapted to making durable paper. Taylor and Cook applied for the patent on March 16, 1912. The application was granted on May 2, 1916, and they received a lifetime patent. The patent is now expired [4].

The high number of paper demand causes the need for alternative raw material that is other than wood for wrapping paper industry. The production starts with the process of pulp making. The raw material to produce

pulp is the cellulose in the form of fiber in which almost all of the plants contain the cellulose that can be used as the raw material of pulp production. One of the plants containing high cellulose is the banana.

Raw banana paper has a coarse surface due to the presence of hemicellulose, lignin, and other waxy components in the fiber. Hemicellulose is located between and within the cellulose fibrils and is incorporated into the cellulose structure. The fiber or pulp with high hemicellulose content has a high maximum tensile strength and a low maximum tear index. The cellulosic fibers enclose the outside of cellulose fibers, acting as natural binders. Long wrapped fiber bundles are a key component of banana paper. Length is also a significant fiber property, as longer fibers contain more fiber joints. These fiber joints contribute to a stronger network of fibers. Long fiber manufactured papers usually have better strength properties than short fiber manufactured papers [5].

Banana fiber can vary in weight and thickness depending on the specific part of the banana stem used. Sturdy, thick fibers can be taken from the outer sheaths, and softer fibers can be extracted from the inner sheaths [6]. The properties of banana paper overall include a lower density, higher stiffness, higher disposability, higher renewability, and higher tensile strength compared to traditional paper [7].

Today banana stem is used as a source of raw material for preparation of a paper pulp. This pulp is used to prepare different types of paper such as tissue, blotting, tracing and writing printing paper. Banana stems are easily available and cultivated in large scale at the North Eastern (NE) region of India. After harvesting, the farmer cuts the banana trees and throws away enormous amount of these stems into the fields because after harvesting the fruit, there is no significant use of banana trees. Constructing a tissue paper through the banana stem will be good for farmers because after harvesting the fruit there is no use of this but using the banana stem for the production of tissue paper will help the farmers get some money and will increase their interest in cultivating banana crops. Several industries manufacture the tissue paper using bamboo, hardwood, softwood and jute etc. as the raw material, because it contains very good percentage of cellulose. On this basis, banana stem acts as a very suitable alternative raw material, containing very good percentage of cellulose [8-9]. Banana trees separate into mainly three parts viz. leaves, stem and roots but the leaves and roots are cut out as it has no use. Cellulose is the main Raw Material for tissue paper and the stem part of banana trees contain the highest percentage of cellulose [10-11].

The paper can be handmade or produced by machinery. Both the handmade and machine processes have similar steps. First, banana stems are collected as they contain more than 4% fiber which can be used to manufacture banana paper. The fiber from the banana is removed and washed in order to eliminate natural resins that can decrease the strength and durability of the paper. The washed fibers are used to form a stronger fiber (agricultural fiber). Then, the process of pulping makes pulp used in the production of paper. This pulp is used to produce the post-consumer fiber and is mixed with the agricultural fiber. Lastly, the mixed fibers are either molded together by a deckle (a tool used for handmade processes of molding fibers) or a machine [12].



Banana plant paper

Process of making pulp and paper:

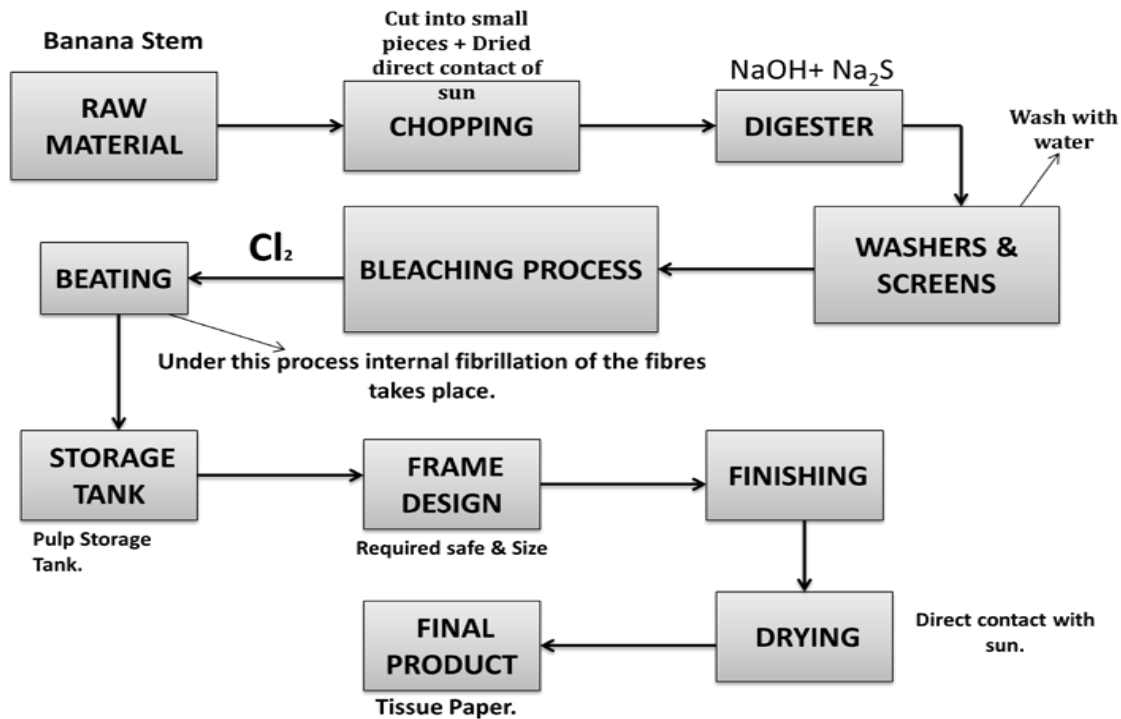
Chopping of the banana stem waste, after harvesting of the fruits procured as raw material and is then that banana stem cuts into small pieces (approximately 4-5 cm) that is called chopping of the banana stem. After those small pieces of banana stem drying in the sun up to 90% drying of the banana stem. Sulfide process is used for making of pulp as a feed of paper machine. This process removes the lignin and hemicelluloses after cutting of banana stem as a small piece which digesting the banana stem chips with high pressure steam and successive use of sodium hydroxide, sodium sulphide and sodium hypochlorite. This process of chemical pulping is used to separate the lignin percentages of lignocelluloses from the cellulose and improve the brightness of the pulp. The lignin percentage in the pulp is determined with the help of kappa number. The effective viscosity, rheology and concentration of the pulp also determines with the help of rotational viscometer, Rheometer and Consistency tester. The pulp behaves like time independent non-Newtonian pseudo-plastic flow behavior. The pulp is used to prepare the several types of paper. But here we used for preparation of tissue, blotting and tracing paper. Calcium carbonate is used as a sizing material We have to observe several properties of the paper pulp and paper such as strength (tear factor, burst factor, tensile strength), °SR (freeness), smoothness, formation, brightness and air permeability of the paper.



Banana Trees



Banana Stem Fiber



Flow sheet diagrams.

Steps in banana fiber production



After bananas are harvested from plantations, the stems and trunks are usually discarded. However, these parts contain available sources of fibers. If the scrapped stems and trunks are utilized, this can lead to a decrease in synthetic fiber production. Synthetic fiber production requires extra energy, fertilizer, and chemicals. Banana paper does not require any chemicals to be used during manufacturing. Banana paper is also more durable and has a longer lifetime than conventional paper. Therefore, the manufacturing of banana paper does not add to environmental pollution. Banana paper reduces pollution by having lower disposal costs and less agricultural waste enter landfills and rivers. The production of banana paper uses less energy compared to traditional paper

production as the traditional paper industry is one of the largest sources of energy consumption. Therefore, banana paper is less impactful on natural resources, such as forests [13-16].

Banana paper making (steps by step)

- Banana bark fibers cut into pieces of 1-2 inches.
- The pieces cooked for around 2 hours.
- Washed the cooked fiber with water.
- Convert into a pulp with a help of mixer or mechanized beater.
- The pulp is mix with some water in a small horizontal tank or bucket.
- Make a mold of a wooden frame (you will also use a wooden photo frame) covered with nylon cloth. for more production, you will use an industrial automated process.
- A sheet of pulp is formed over a mold by pouring it into a small tank or bucket containing pulp.
- Keep it in the sun to dry.
- A pile of dry banana paper sheets.
- The dried sheets are rolled between two rollers for smoothness and then cut into a required.



Banana fiber paper

Banana Paper uses: -

- Banana Paper is used for disposable dishes, paper cups, disposable glass and even it is best to carry bag making.
- Paper is also used for gents and ladies' wallets.
- It is used for making handicrafts and home decor.
- In various regions, banana paper is also used for artistic purposes also.
- The banana paper is used for currency notes in Germany and a trial run in India also.

- During the research, it was found that banana paper made out of banana bark has a shelf life of over 100 years as it is the strongest of the long fibers ever found amidst natural fibers.
- It can be folded for as many as 3,000 times. It can use currency and value-able documents.
- Designers used banana paper for printing business cards and greeting cards, beautiful visiting cards, wedding cards.
- The banana paper also used for making gift boxes, notebook covers, drawing paper.
- Banana paper is best for sanitary towels.
- The artesian uses Banana paper as an art paper alternative.
- Also, banana paper is used for filter paper, pen stands, photo frames, lampshades, and many more.
- This paper is used for the purpose of writing.
- Plastic is often used as wrapping material but is environmentally harmful. The banana paper can effectively replace plastic.
- This Banana paper can be used to store food and to serve foodstuffs.
- It can be used for various handicrafts and arts such as Origami.

I made a banana paper from the banana bark at my home, with very less equipment. the banana paper made by me is of good quality and will be of better quality if made by the industrial process.

Banana Fiber Paper Craft made by me



Banana Paper lamp-shade

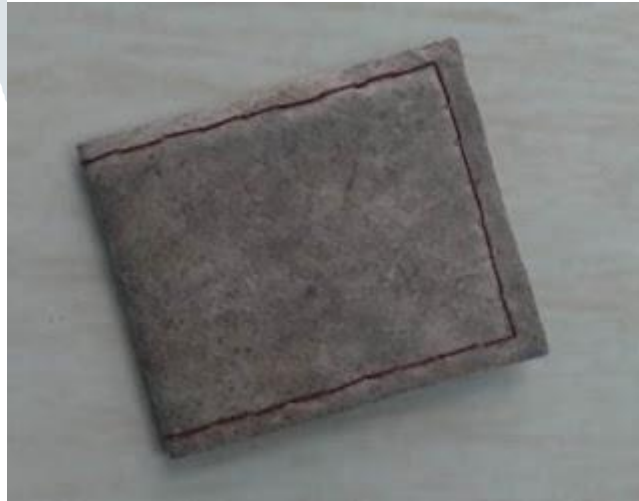


Banana Paper lampshade

Banana Paper gents Wallet



Banana paper wallet



Banana paper wallet



Banana Paper Wallet

Banana Paper ladies Wallet



Banana paper wallet

Banana Paper Box



Banana paper box

Banana Paper Bag



Handmade banana paper bag



Banana Paper Bag

Banana fiber has its own natural color so the paper is not clear white but it is half white. It is possible to make it clear white but we need to add chemicals in the process. The thickness of the banana fiber paper is maintained as per requirement. I make banana paper in various thicknesses (60 GSM to 200 GSM) like tissue paper to the card sheet.

Conclusion

This study helps to show that the banana fibre can be used to make an extremely useful product which can be applied in many ways as stated above. The product can effectively replace several other products which are environmentally harmful and are difficult to dispose. The study is intended to find the perfect application of plant waste which is environmentally not harmful.

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