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## TITLE: PRODUCTION OF PAPER USING BANANA STEM

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### Abstract

*In recent decades, the use of paper has increased drastically. The paper industry is one of the most important industries, but for production of good quality of paper it require a lot of energy and water and during this process it emits hazardous gases. Keeping this in mind, we can produce paper from alternative source i.e. banana stem. Due to scarcity of traditional raw material i.e. bamboo and also bamboo is getting costlier day by day. After harvesting of banana, the stems are left as a waste on ground, which emits harmful gases (CO<sub>2</sub>). So to avoid waste and to produce best from waste, we have taken a step to produce paper from banana stem. By giving this idea to young entrepreneurs, we can contribute to reduce the unemployment in our country.*

**Keyword:** Paper, Hazardous gases, Banana stem

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## 1. INTRODUCTION

Banana is an important fruit crop which belongs to genus Musa. It grows wild and also cultivated on large scale as a field crop as well as a backyard crop in households. India has over 186,000 hectares of land under banana cultivation yielding 200,000 tons of banana fibre .The plant shows luxuriant growth in rich well drained soil with ample moisture and decaying organic matter. It can also grow on sandy or gravelly soil as well as on clay, if the soil is fertile and facilities for irrigation are available.<sup>1</sup>

In India the banana plants are abundantly cultivated mainly in Maharashtra, Andhra Pradesh, Orissa, Bengal, Assam and Tamil Nadu and also in some parts of Karnataka. With the increasing demand for banana in both the Indian and International markets, the production are expected to increase in the coming years.

Presently for preparation of a paper pulp banana stem is used as a crude material. For preparation of different types of paper such as bloating paper, tissues, tracing, writing and printing paper pulp from banana stem is widely used. After harvesting, the farmer cuts the banana trees and throws away huge amount of these stems into the fields because after harvesting the fruit, there is no significant use of banana trees. The Banana stem which is thrown away can be used to prepare tissue paper and this will help the farmers get some extra income and will increase their interest in growing banana crops. As bamboo, contains very good percentage of cellulose it is used as a raw material for production of paper. Considering this banana stem acts as a reliable alternative raw material which contains very good percentage of cellulose. Banana trees separate into mainly three parts viz. leaves, stem

and roots but the leaves and roots are thrown away because it is a waste. Cellulose is the main Raw Material for tissue paper and the stem part of banana trees contain the highest percentage of cellulose.<sup>2</sup>

Being a rich source of natural fibres, the stem can be economically utilized for numerous applications and preparation of variety of products. The different uses of banana stem consist of manufacturing paper, fibre, board, writing paper and tissue paper. As a point of cost, the banana stem raw material is cheaper than wood.<sup>3,4</sup>

### 1.1 The life-cycle of the banana tree

After the fruit is harvested the question is what happens to the tree. So the answer is that apart from apple, mango and other varieties of fruit-bearing trees, banana plant only fruit once in their lifetime and then they die naturally after fruits are harvested. Bananas tree are different than other tree as we see the stem of the plant is what looks like the trunk of the 'tree', but it is actually tightly packed leaf sheaths that overlap as it grows and in this way width of stem goes on increasing. The creepy underground stem and root system is the most enchanting feature of banana tree. The life of banana stem is five years which mean it can bear fruit for five years and after that it should be cut down. The new offshoot from the banana stem or root is emerging which means the new plant can be grown from this offshoot. To encourage the growth of new offshoot the main stem is cut down by the farmers.<sup>5</sup>

## 2. METHADODOLOGY

### 2.1 MATERIALS

### 2.1.1 Banana stem

The Banana stem have been obtained from farming area of Yavatmal. Banana stem may serve as a good alternative resource in fibre based industries. The banana fibers possess good physical strength properties. Banana fibers also have good cellulosic content which can be used in paper and pulp industry. When banana fruit has been harvested from the tree the stem of banana tree is thrown as waste which releases harmful gas such as CO<sub>2</sub> so to avoid this we can use banana stem for making paper.



**Fig-2.1.1:** Banana stem

### 2.1.2 Sodium hydroxide (NaOH)

Sodium hydroxide, also known as caustic soda, has the molecular formula NaOH. It is accessible in market in form of pellets, flakes, and granules and usually white in colour. Sodium hydroxide is soluble in water and alcohol. This alkali is hydrophilic and readily absorbs moisture from Air. Sodium hydroxide is basic in Nature and generally used in the manufacture of pulp and paper, textiles, drinking water and soap sand detergents and as a drain cleaner.



**Fig-2.1.2:** Sodium hydroxide

Physical properties:

Molar mass: 39.997 g/mol

Appearance: White, waxy, opaque crystals

Odour: Odourless

Density: 2.13g/cc

Melting point: 591 K

Boiling point: 1661 K

### 2.1.3 Bleaching agent

Bleaching power was used as bleaching agent. It is also called as calcium ox chloride or chloride of lime. It was used to remove yellow colour of paper and to make it clean.

## 2.2 METHODS

### 2.2.1 Cutting and chopping of raw material

As the raw material was brought from field after harvesting, the skin of the banana stem has removed. Then we started to remove the layers and layer of the banana stem. After that we chopped each layer into long strips which is near about 15-20cm long.



**Fig-2.2.1:** Chopped banana stem

### 2.2.2 Drying

As soon as we have chopped the banana stem into long strips we have kept this material for drying. We have kept it for drying for three days in sunlight. To fasten this process we can use tray dryer and oven. After drying the product the water content in the stem gets evaporated. Blow figure shows banana stem after drying.



**Fig-2.2.2:** Dried banana stem**2.2.3 Cooking**

Before cooking the dried banana stem we have chopped the large string into small of 1inch. We have prepared a solution of NaOH by adding 64 grams of NaOH in 400ml of water. Then we added 16 grams of dried banana stem into solution and cooked it for 5 hours at 90°C to 100°C. In between as the water level has gone down we have makeup the slurry by adding water.

**Fig-2.2.3:** Cooking of dried banana stem**2.2.4 Washing**

After 5 hours the cooked slurry is washed with water we get black liquor. Rinse the cooked fibre carefully to remove sodium hydroxide content this step should be repeated. Then alternately use runoff of tap water to remove sodium hydroxide and the put this into a mesh so that the excess water get strained.

**2.2.5 Blending**

After washing the slurry we have blended the washed pulp in blender and again when blending is completed we have washed the slurry 5-6 times so that any traces of NaOH is washed away.

**Fig-2.2.5:** Blending of pulp**2.2.6 Drying and Blending**

As blending process is completed we have left the wet pulp for drying in sunlight for one day when total moisture is absorb from the wet pulp we get dry pulp it looks like a sheet but without uniform dimension.

**2.2.7 Bleaching and Drying**

The dimensionless sheet is then bleached using bleaching powder ( $\text{CaOCl}_2$ ). This bleached pulp is then dried in sunlight for 6-7 hours. After drying we get clean n clear white non uniform sheet.

**2.2.8 Blending**

This clean white non uniform sheet is then blended in blender with water i.e. 700ml. After this fibres were strained to remove water. Use your finger to disturb the blended fibres this thick paste is put in a mould to get a uniform dimension.

**2.2.9 Pressing**

Thick paste is allowed to dry in screen. Then this dried part is removed on butter paper, some weight is kept on paste this process is called pressing. This weight is kept for hours on that material. And we get our final product that is paper.

**Fig-2.2.9:** Thin screen paper**Fig-2.2.9:** Thick screen paper**3. RESULT AND DISCUSSTION**

Cellulose and lignin contents are concerned mainly by paper industry. The cellulose is required and lignin is not required content. Banana stem contains very low content of lignin as compared to other sources. The lignin content combine with cellulose and it causes the hardness of the stem. In paper industry it is essential to separate lignin from cellulose, by using other traditional sources like wood required highly cruel chemicals for the separation of lignin from cellulose but in case of banana stem there is a very low content of lignin is present which can be easily removed and we don't need to use cruel chemicals additives during processing. So in this way the paper making from banana stem is environmental friendly and also as banana stem is a cheap and easily available.

### 3.1 Thin screen paper

Colour of paper: - Light brown

Dimensions of paper: - 10×10 Cm

Weight of paper: - 3.567 gm

GSM (gram per square meter) =  $3.567 \times 100 = 356.7$  GSM

### 3.2 Thick screen paper

Colour of paper: - Light brown

Dimensions of paper: - 10×10 Cm

Weight of paper: - 3.944 gm

GSM (gram per square meter) =  $3.944 \times 100 = 394.4$  GSM

## 4. CONCLUSION

The study shows in past bamboo was used to prepare paper and recently Banana stem which is wasted after harvesting fruits is good cellulosic source and contains very low content of lignin can be used as an alternative source for production of paper. The wasted banana stem also causes environmental pollution so if it utilize can reduce pollution. It can produce a good quality paper.

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