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## Production of paper from banana stem by Kraft process

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### Abstract

Banana stem is well collected from banana trees once assortment of banana fruits. The stem is employed as a waste matter and employed in domestic preparation purpose. principally activity is employed to gather the polyols from the polymer. polymer is separated from the lignocelluloses. it's removed once cutting of banana stem in little items so stem is processing within the sterilizer at a high and consecutive use of caustic soda, Na compound and bleach. The fibre is liquified and creating pulp. alphabetic character range is employed to understand the polymer proportion within the pulp. This pulp is employed to organize the tissue, bloating and paper. This method of pulp and paper creating is economically viable and its energy saving as sun ray is employed for drying purpose.

**Key words:** Banana, pulp, paper, energy

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### 1. Introduction:-

Today banana stem is used as a provider of stuff for preparation of a paper pulp. This pulp is used to prepare differing kinds of paper like tissue, bloating, tracing and writing printing paper. Banana stems are simply on the market and cultivates in large scale at the North Jap (NE) region of Asian country. once gathering, the farmer cuts the banana trees and throws away large amount of these stems into the fields as a result of once gathering the fruit, there is no very important use of banana trees. Constructing a paper through the banana stem area unit wise for farmers as a result of once gathering the fruit there is no use of this but victimisation the banana stem for the assembly of paper will facilitate the farmers get some money and may increase their interest in culminating banana crops. several industries manufacture the paper exploitation bamboo, hardwood, softwood and jute etc. as a result of the things, as a result of it contains excellent proportion of polyols. On this basis, banana steam acts as a awfully appropriate completely different stuff, containing excellent proportion of sugar. Banana trees separate into mainly 3components viz. leaves, stem and roots but the leaves and roots are cut out as a result of it's no use. sugar is that the most stuff for paper and thus the stem a neighbourhood of banana trees contain the most effective proportion of cellulose. In the North Jap region of Asian country, several varieties of banana trees are found, one among that's monocot genus. North jap region of Asian country has very acceptable weather for banana crops. monocot genus is cultivated in large scale

moreover as a result of it contains excellent proportion of cellulose.

In manufacturing of the paper, polymer creates the matter as a result of it cannot be merely separated due to the unit linkage of sugar. polymer may be a mixture of phenolic resin groups and it interconnects with the polyols and thus the resultant bond is improbably sturdy. but delignification is improbably very important to urge a high-quality pulp as a result of relating to 85-90 pp. polymer separations ought to be finished making a white paper. Removal of 85-90 pp. polymer implies that white pulp is formed as a result of the brightness of the pulp depends upon the removal of the polymer proportion. The extent of polymer removal is defined by the use of letter of the alphabet vary. letter of the alphabet range is directly proportional to the proportion of polymer removal, thus with the decrease in chemical compound removal proportion there is a decrease among the letter of the alphabet vary. In making a pulp, we tend to sometimes perceive the three processes i.e. salt methodology (also called wrapping paper process), sulphite, and soda methodology are acceptable. in addition, various semi- chemical, mechanical and semi mechanical is used.

In production of a paper through the banana stem, paper pulp methodology is most popular. it is the oldest and extremely noted methodology to arrange a pulp. The paper methology was discovered in European country in 1879 and was initial applied in Swedish mill in 1885. once at the beginning paper was factory-made through the paper methodology, the paper obtained was a lot of stronger than

any paper antecedent factory-made. A dark brown pulp is obtained through this methodology afterwards through the bleaching methodology, a white pulp is obtained and this pulp offers an awfully sensible strength paper. Among the foremost recent developments in paper business for production of paper, banana stem acts as a superior material and it provides simply manufacturable strength paper . the various uses of banana stem carry with it manufacturing grease proof paper, fibre, board, paper and paper. As some extent of economy, the banana stem stuff is cheaper than wood. In the gift scenario of the north Jap region of land, still the economic state of affairs is not never the less increased, therefore, on this basis, a tiny low plant for production of tissue need to be stabilized which might be very useful for the society and its surroundings.[1]

## 2.Raw Material:-

### 2.1 Banana Stem:-



**Fig-1:** Banana Stem

### 2.2 Sodium hydroxide:-

Sodium hydroxide, additionally referred to as caustic or hydroxide, has the molecular formula  $\text{NaOH}$  and is extremely caustic antimonial base. it's a white solid offered in pellets, flakes, granules, and as a five hundredth saturated solution. sodium hydroxide is soluble in water, ethanol and wood alcohol. This alkali is deliquescent and without delay absorbs wet and  $\text{CO}_2$  in air. Sodium hydroxide is employed in several industries, largely as a powerful chemical base within the manufacture of pulp and paper, textiles, drink, soap sand detergents and as a drain cleaner. Worldwide production in 2004 was close to sixty million tonnes, whereas demand was fifty one million tonnes. though liquid hydrated oxide possesses properties almost like those of the opposite forms, its extreme temperature relatively limits its applications.



**Fig-2:**Sodium hydroxide

Physical properties

Molar mass 39.997 g/mol

Appearance White, waxy, opaque crystals

Odour inodorous

Density 2.13g/cc

Melting point 591 K

Boiling point 1661 K

### 2.2 Sodium carbonate

Sodium carbonate,  $\text{Na}_2\text{CO}_3$  may be a Na salt of carbonic acid. It most ordinarily happens as a crystalline heptahydrate, that without delay effloresces to create a white powder, the hydrate. sodium carbonate is domestically documented for its everyday use as a softener. It will be extracted from the ashes of the many plants. it's synthetically created in giant quantities from salt (sodium chloride) and stone during a method referred to as the Solvay process.



**Fig-3:**Sodium Carbonate

Physical properties:

Molar mass 105.9885 g/mol

Appearance White solid

Odour inodorous

Density 2.54 g/cc

Melting point 851 °C

Boiling point 1633 °C

### 2.3 Sodium sulphide:-

Sodium sulphide is that the substance with the formula  $\text{Na}_2\text{S}$ , or additional usually its hydrate  $\text{Na}_2\text{S}\cdot 9\text{H}_2\text{O}$ . each area unit colourless soluble salts that offer powerfully alkaline solutions. once exposed to dampish air,  $\text{Na}_2\text{S}$  and its hydrates emit atomic number 1 sulphide, which smells like rotten eggs. Some business samples area unit such as  $\text{Na}_2\text{S}\cdot x\text{H}_2\text{O}$ , wherever a weight percentage of  $\text{Na}_2\text{S}$  is such as. usually offered grades have around hour  $\text{Na}_2\text{S}$  by weight, which suggests that  $x$  is around three. Such technical grades of Na chemical compound have a yellow look as a result of the presence of polysulphides. These grades of sodium chemical compound are marketed as 'sodium sulphide flakes'. although the solid is yellow, solutions of it area unit colourless.



**Fig-4:**Sodium Sulphide

Physical properties:

Molar mass 78.0452 g/mol

Appearance colourless, hygroscopic solid

Odour rotten eggs

Density 1.856 g/cm<sup>3</sup>

Melting Point 1449K

### 3. Method:-

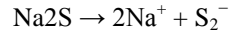
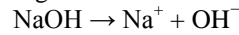
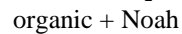
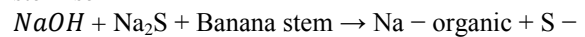
#### 3.1 Method of Manufacturing of pulp:-

Chopping of the banana stem waste, after harvesting of the fruits procured as stuff and then banana stem cuts into smaller pieces (approximately 4-5 cm) process is referred as chopping of the banana stem, then the banana stem is dried up to 90%. Methodology is used for making of pulp as a feed of paper machine. This method removes the polymer and hemicelluloses once cutting of banana stem as a little items that digesting the banana stem chips with atmosphere steam and ordered use of caustic soda, metal compound and bleaching agent. This methodology of chemical pulping is used to separate the polymer percentages of lignocelluloses from the polyose and improve the brightness of the pulp. The polymer share within the pulp is decided with the help of letter of the alphabet range. The effective consistence, natural philosophy and concentration of the pulp conjointly determines with the assistance of motion viscosimeter, Rheometer and Consistency tester. The pulp behaves like time freelance non-Newtonian pseudo-plastic flow

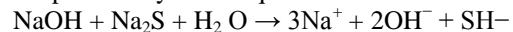
behavior. The pulp is employed to organize the many sorts of paper. however here we tend to use for preparation of tissue, bloating and paper. carbonate is employed as a size material we've got to watch many properties of the paper pulp and paper like strength (tear issue, burst issue, tensile strength), <sup>0</sup>SR (freeness), smoothness, formation, brightness and air permeabilizes of the paper. [1]

Generally chemical pulping is completed by cooking the Banana Stem throughout a sterilizer (like five liters pressure cooker) at high temperature and pressure that dissolve the polymer and leave behind the polyols. each pulping trial was distributed on fifty gram of banana stem. throughout a typical

Reactions of chemical compound technique at intervals the steriliser



Kraft cook, Associate in Nursing solution of chemical element hydroxide/sodium sulphide/water, collectively known as white liquor, is reacted with the raw materials throughout a pressure vessel known as a steriliser. The white liquor and thus the banana stem chips are heated to a cooking at more or less 105°C, this cooking temperature and time are generally for softwood fibres. throughout this treatment, the hydroxide and hydrosulphide anions react with the polymer, inflicting the compound to portion into smaller water/alkali-soluble fragments. There are several variations in cooking technique every for the batch and continuous steriliser. at a lower place high temperature and pressure chemical compound and polyols degrade to convey fragments that resolvable at intervals the powerfully basic liquid.



The ensuing pulp was washed through the new water and grind through the grinder mixer. Finally created the suspension type of thick paste and every one once more washed with quandary. The pulp was processed throughout a defibrate to separate the fibre, the screened on seventy and ninety-five mesh sieves. The rejects were maintained on seventy mesh sieves. once screened of the pulp {once additional| another time yet again over again all over again}boil with water if once boiling is begin then additional up to fifty to sixty minutes of the bleaching agent and heated up to forty five minutes and once more washed through the new water and this technique repeat two three times as a results of the thick paste at first within the black colour once boiling the .sodium hypochlorite and continual this technique two three time and acquire colourless answer (through this technique remove the black colour of the pulp ) and this technique is in addition known as bleaching technique. once the bleaching technique in the pulp or colourless answer all over again cooked with water and more the carbonates (up to 5-6%) as a result of Ca carbonate offers the soft and white tissue. [1]





**Fig-5:** Dried banana stem

**Table No 1:** Composition of Banana Fibre

Sr. No.	Constituents	Percentage
1	Cellulose	32.5 ±0.5
2	Hemi Cellulose	14.72 ± 2.15
3	Lignin	15.12 ± 0.76
4	Moisture	9.5 ± 1.5
5	Residual gum	41.90
6	Total cellulose	81.80
7	Ash	8.25 ± 0.14

**Table No 2:** Name of the equipment uses in pulp and paper testing quality

**3.2.1. Impregnation:**

Common wood chips employed in pulp production square measure 12–25 millimetres (0.47–0.98 in) long and 2–10 millimetres (0.079–0.39 in) thick. The chips commonly initial enter the pre-steaming wherever they're wetted and preheated with steam. Cavities within recent wood chips square measure part stuffed with liquid and part with air. The steam treatment causes the air to expand and regarding twenty fifth of the air to be expelled from the chips. ensuing step is to impregnate the chips with black and white liquor. Air remaining in chips at the start of liquor, impregnation is at bay inside the chips. The impregnation is done before or when the chips enters the steriliser and is often done below 100°C (212°F). The change of state liquors incorporates a mix of white liquor, water in chips, condensed steam and weak black liquor. within the impregnation, change of state liquor penetrates into the capillary structure of the chips and coldness chemical reactions with the wood begin. an honest

Sr. No.	Properties	Name of the equipment
1	GSM	GSM Tester
2	Tear factor	Tear Factor Tester (Presto)
3	Burst Factor	Mullen tester
4	PH	PH meter
5	Tensile Strength	Allerton TH-1
6	Roughness	Air-leak Tester
7	Effective viscosity	Rotational viscometer
8	Pseudoplastic flow behaviour	Rheometer
9	Pulp Consistency	Consistency

impregnation is vital to induce a homogenised cook and low rejects. regarding 40–60% of all alkali consumption within the continuous method happens within the impregnation zone.

**3.2 KRAFT'S METHOD: -**

The wrapping paper method (also referred to as wrapping paper pulping or sulphate method) could be a process for conversion of wood into pulp consisting of just about pure polysaccharide fibres. It entails treatment of wood chips with a mix of hydroxide and metallic element chemical compound, referred to as white liquor, that breaks the bonds that link polymer to the polysaccharide. The wrapping paper method is that the dominant chemical pulping methodology. It involves following operations:

**3.2.2. Cooking:-**

The wood chips square measure then grilled in Brobdingnagian controlled vessels known as digesters. Some digesters operate in batch manner and a few in continuous processes. There square measure many variations of the change of state processes each for the batch. Digesters manufacturing one,000 plenty of pulp per

day and a lot of square measure common with the most important manufacturing quitethree,500 tonnes of pulp per day. in an exceedingly continuous steriliser, the materials square measure fed at a rate that permits the pulping reaction to be complete by the time the materials exit the reactor. Delignification needs many hours at one hundred thirty to 180°C (266 to 356°F). beneath these conditions' polymer and hemi polysaccharide degrade to administer fragments that square measure soluble within the powerfully basic liquid. The solid pulp (about five hundredth by weight supported the dry wood chips) is collected and washed. At this time the pulp is kind of brown and is thought as brown stock. The combined liquids, referred to as black liquor (so known as attributable to its colour), contain polymer fragments, carbohydrates from the breakdown of hemi polysaccharide, Sal soda, sulphate and different inorganic salts.

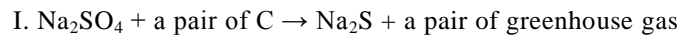


**Fig-6:** Cooking

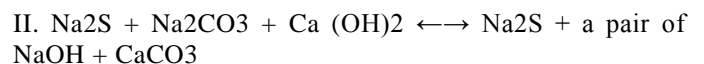
### 3.2.3.Recovery method:-

The surplus black liquor is at concerning V-J Day solids and is focused during a multiple result evaporator. once the primary step the black liquor is concerning twenty - half-hour solids. At this concentration the rosin soap rises to the surface and is fatless off. The collected soap is more processed to oil. Removal of the soap improves the evaporation operation of the later effects. The weak black liquor is more gaseous to sixty fifth or perhaps eightieth solids ("heavy black liquor") and burned within the recovery boiler to recover the inorganic chemicals for use within the pulping method. Higher solids within the focused black liquor will increase the energy and chemical potency of the recovery cycle, however additionally provides higher consistency and precipitation of solids (plugging and fouling of equipment). The combustion is

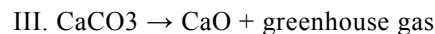
disbursed such sulphate is reduced to atomic number 11 chemical compound by the organic carbon within the mixture:



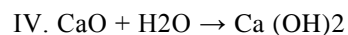
This reaction is comparable to thermo chemical sulphate reduction in chemistry. The liquid salts ("smelt") from the recovery boiler area unit dissolved in method water called "weak wash". This method water, additionally called "weak white liquor" consists of all liquors accustomed wash lime mud and inexperienced liquor precipitates. The ensuing answer of salt and atomic number 11 chemical compound is understood as "green liquor", though it's not well-known specifically what causes the liquor to be inexperienced. This liquid is mixed with quicklime, that becomes hydroxide in answer, to regenerate the white liquor employed in the pulping method through associate equilibrium reaction (Na<sub>2</sub>S is shown since it's a part of the in experienced liquor, however doesn't participate within the reaction):



Calcium carbonate precipitates from the white liquor and is recovered and heated during a lime oven wherever it's regenerated to quicklime (lime).



Calcium oxide (lime) is reacted with water to regenerate the hydroxide employed in Reaction II:



The combination of reactions 'I' through 'IV' Forms a closed cycle with relevancy atomic number 11, sulphur and metal and is that the main thought of the questionable re-caustic zing method wherever salt is reacted to regenerate caustic soda. The recovery boiler additionally generates air mass steam that is fed to turbo generators, reducing the steam pressure for the mill use and generating electricity. a contemporary wrapping paper pulp generation associated unremarkably can give a web flow of energy which might be employed by an associated manufacturing plant or oversubscribed to neighbouring industries or communities through to the native electrical grid. to boot, bark and wood residues area unit usually burned during a separate power boiler to come up with steam.

### 3.2.4.Blowing:-

The finished fried wood chips area unit blown by reducing the pressure to gas pressure. This releases plenty of steam and volatiles. The steam made will then be accustomed heat the pulp mill and any excess employed in district heating schemes or to drive a turbine to come up with power.

**3.2.5. Screening:-**

Screening of the pulp once pulping may be a method whereby the pulp is separated from giant Shives, knots, dirt and different scrap. settle for is that the pulp the fabric separated from the pulp is named reject. The screening section consists of various styles of sieves (screens) and centrifugal improvement. The sieves area unit unremarkably came upon during a period cascade operation as a result of appreciable amounts of fine fibres will move to the reject stream once making an attempt to attain most purity within the settle for flow. The fibre containing shives and knots area unit separated from the remainder of the reject and reprocessed either during a skilled worker and/or is distributed back to the steriliser. The content of knots is usually zero.5 - 3.0% of the steriliser output, whereas the shives content is concerning zero.1- 1.0%.

**3.2.6. Washing:-**

The brown stock from the processing goes to the laundry stages wherever the used preparation liquors area unit separated from the polyol's fibbers. unremarkably a pulp mill has 3-5 laundry stages nonparallel. laundry stages also are placed once chemical element delignification and between the bleaching stages still. Pulp washers use counter current flow between the stages such the pulp moves within the wrong way to the flow of laundry waters. many processes area unit involved: thickening / dilution, displacement and diffusion. The dilution issue is that the live of quantity the quantity the number} of water employed in laundry compared with the theoretical amount needed to displace the liquor from the thickened pulp. Lower dilution issue reduces energy consumption, whereas higher dilution issue unremarkably provides cleaner pulp. Thorough laundry of the pulp reduces the chemical chemical element demand (COD).

Several styles of laundry instrumentality area unit in use:

- Pressure diffusers
- Atmospheric diffusers
- Vacuum drum washers
- Drum displacers
- Wash presses

**3.2.7 Bleaching:-**

In a fashionable mill, brown stock (cellulose fibres containing roughly five-hitter residual lignin) made by the pulping is 1st washed to get rid of a number of the dissolved organic material so more delignified by a spread of bleaching stages. The pulp made up to the present purpose remains in brown colour due within the method are often bleached to provide a study product. The chemicals accustomed bleach pulp is a supply of environmental concern, and recently the pulp trade has been victimisation alternatives to Cl, like bleaching agent, oxygen, gas and oxide. within the case of a plant designed to provide pulp to create brown sack paper or linerboard for boxes and packaging, the pulp doesn't forever have to be compelled to be bleached to a high brightness. Bleaching decreases the mass of pulp made by concerning

five-hitter, decreases the strength of the fibres and adds to the price of manufacture. [3]



**Fig-7: Paper**

**4. CONCLUSION**

Banana stem is also a least pricy and easily accessible staple as a offer of making paper pulp for the assembly of varied varieties of paper. The technique of making pulp is economically violable. The chemical compound separated from polyols with the help of chemical treatment. Sun ray is utilized for drying operation of paper mat. consumed from nature and in line with economic stand it's profitable

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[3].The process name is derived from German Kraft, meaning "strength" in this context, due to the strength of the Kraft paper produced using this process. Both capitalized and lowercase spelling ("Kraft process" and "kraft process") appear in the literature, but "Kraft" is most commonly used in the pulp and paper industry.

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