Banana Tree Pulping

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ABSTRACT

Acid hydrolysis with 2% acid on Banana tree resulted in segregation of fibres from the banana mucilaginous material. After opening and washing, the fibres can be pulped by normal process. The pulp obtained is equivalent to Pine Wood pulp with better double folds. It is suitable for various speciality papers like Greaseproof, Parchment, Bank Notes, Stencil Tissue, Tea Bag, Multiwall Paper Bags etc.

Many people have tried earlier to make pulp from banana fibre. In all cases the process followed was similar to other fibre pulping, i.e. mechanical cutting and chemical pulping by normal process of digesting etc. Everywhere it was found that the pulp is extremely slow in drainage resulting in uneven formation and only thick papers for packaging. In Japan mechanical means were adopted for extraction of fibres, but it damages these fibres and yet the pulp is not suitable for writing/printing papers. The author has not found any reference of similar work as presented in this paper having been done elsewhere. However, references of work done by normal process as indicated above are as given in order 1,2. Other who have done similar work (without removal of mucilaginous material) are given below:

a) Central Food & Technological Institute, Mysore evolved a process of treating stem with hot aqueous solution of metallic salts, which produced thick paper for packaging and could be used as a cushioning material for fragile materials like glass or for packaging.
b) Transform Australia also developed in 2003 a process for use of entire banana stem (without removal of mucilaginous material). It also could be used for packaging paper only.

Hence a new method has been developed in laboratory as given below.

The Banana stems are cut into 25-40 mm discs and sun dried in fields until moisture reduces to 10%. This reduces transport cost and avoids degeneration of fibres. The chips are treated with 2% sulphuric acid or 2% HCL for 60 minutes at 120ºC. At plant scale this can be done in S.S. Pandia type digesters. The yield of crude fibres and mucilaginous material was 28% and 34.5% respectively on OD basis. Mucilaginous material is also cellulose and contains 65% holocellulose and hence is important by product. It should be possible to use this for producing other products.

After pretreatment, chips were refined in double disc refiner first with 80 thou clearance and second passage with 45-50 thou clearance. First passing of 80 thou clearance is necessary to avoid choking of plates and damage to fibre. After refining, crude fibres are separated by screening on perforated open screen with opening of 1.5 mm and washed thoroughly.

From crude fibres, pulp of 25 kappa no. was obtained with 12.5% chemical charge (as Na_2O) by sulphate process at 162ºC. The yield was as high as 59%. Plant scale pulping should be done in Pandia digesters to avoid heavy packing of fibres. The best bleaching was obtained by CEH sequence with 6.5% total chlorine giving pulp viscosity 18.1 CP (CED), Alkali 1.4% and Hypo 1.5% were applied. Brightness obtained was 78%.

Unbeaten pulps of (both unbleached and bleached) have good strength properties compared to other raw materials. It requires initial beating to 30ºSR. Strength at all levels of slowness is almost double of bamboo pulp and even supercedes some soft wood pulps like pine pulp except in tear factor. Bulk, opacity and porosity is lower than other pulps. Hence Banana pulp is suitable for blending with other hardwood pulps. Average strength characteristics of Banana bleached pulp and comparison with Bamboo and Pine bleached pulp is as given below

As percentage of Banana pulp increases with hardwood pulp, breaking length, stretch, burst factor, tear factor, double folds and overall strength index all increase. Even 20% blending increases strength index by 25%

Beating Banana pulp to 70-80º SR could make strong greaseproof papers. It had all desirable properties of opacity, blister formation etc. which are much higher than ISI standards. The fibers are suitable to make other speciality papers like Parchment, Bank Note, Stencil Tissue, Tea Bag, reproduction and photo papers, multiwall paper bags etc.

Bleached pulp	Banana	Bamboo	Pine
Breaking length-km	12	6.5	11.5
Stretch %	2.2	2.3	3.1
Burst Factor	85	48	80
Tear Factor	100	80	110
Double Folds	3000	80	1700
Strength Index	3000	1800	3040

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The pulp contains long fibres of 3.44 mm and fibre diameter is also on higher side.

Hence it is more flexible and gives superior strength.

The yield of crude fibre was 28% on OD chips. This crude yielded 50% unbleached and 54.3% bleached pulp. On OD chips basis, yield is 16.5% and 15.2%. It is low due to mucilaginous material. However, since it is waste material without any other use, the rew material cost should be very low and also it should give a very good final product (pulp) comparable to imported pine wood pulp and is specially useful for speciality papers indicated earlier.

Acknowledgement:

The above research work was carried out in laboratories of factories with which the author was associated under his suggestions. The intention was to set up a factory for various speciality papers, which have a very high value in an area with high banana plant acreage. Unfortunately some adverse circumstances did not allow the project to fructify and now the author is too old to take up this. In order that this work is not wasted, the author has brought out the final results in this article. He has lot of reports of various tests conducted to achieve the final results.

The author acknowledges the work done by various Scientists to achieve above. Unfortunately the work was done in 1970's and it is now too late to remember the various persons and their contribution.

Conclusion :

Banana fibre is a waste product presently just thrown away. It has no use even as fuel or cattle feed. But its fibre value as indicated above is very high and makes it eminently suitable for high value speciality papers. It can also be used as a part of mix to improve the properties and strengthen pulp from hardwoods as well as from agriculture residues. This would replace imported pine wood pulp, presently used for this purpose. The mucilaginous by- product also containing lot of cellulose can perhaps easily be converted into thick paperboards and with some extra filling into doors and windows panels.

References:

1. "Kraft paper from banana stems" by SRD Guha - Indian Pulp & Paper - Vol. 15, No. 5.
2. "Non wood Plant Fibres Pulping process" - Progress Report by W.T.Hayse.