

Utilisation of Mixed Hardwoods at the Bengal Paper Mill

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The Bengal Paper Mill is pioneer to use mixed hard wood and bamboo in one single street pulp mill and is the first pulp and paper mill in world to use the mixture of different species of hard woods and bamboo in Kamyr Continuous Digester with Hi heat diffusion washing, 16,000 to 18,000 tonnes of paper was annually produced at this mill before 1957. The main raw materials used for pulping were Sabai Grass and Bamboo. After 1957 the mill made rapid progress in modernisation and reconstruction. Now the mill capacity is to produce 50,000 tonnes of pulp per annum. Most of Indian pulp mills are using bamboo as their raw material for pulping. The existing resources of bamboo supply are limited, and bamboo is already in short supply to meet our demand to produce 150 tonnes of pulp per day from 10% bamboo. It is found uneconomical to use Sabai Grass at our mill. Supplies of bagasse are very uncertain and vary from year to year. Other agriculture residue like rice straw are not easily available at economical price and they have very high ash content and pulp yield is also low. After giving much thoughts and considering the availability of the raw material for near future a major step was taken by the Bengal Paper Mill to use mixed hard woods for pulping.

The author had an opportunity to work in a paper mill in North America, where 350 tonnes of nine point corrugating medium board paper per day is manufactured from 100% hard woods (Aspen and Oak) by semi-chemical pulping. Quality bleached Food Board is manufactured from mixed pulping of 50% Aspen and 50% Pine. The author has seen that cold soda pulp manufactured from hard wood is used for newsprint, writing and printing paper.

The author found very encouraging usage of mixed hard wood for manufacture of dissolving pulp for tyre cord and cellophane at International Paper Company at Hawksbury, Canada. Utilisation of

hard woods has been adopted in very large quantity in Europe, U.S.A., Japan, Australia, etc.

Mixed Pulping.—In India it is not economical and feasible to use one particular specie of hard-woods at the mill. No doubt from chemical point of view, it may be better to cook a particular specie of hard wood and bamboo separately for obtaining best result. Mixed cooking of mixed hard woods and bamboo may not be the best technical solution due to their heterogenous chemical composition and density, but it is not possible in actual practice to have separate cooking of different raw materials of heterogenous nature.

The cost of plant and equipment is extremely high, therefore, Bengal Paper Mill adopted cooking the mixture of 60% bamboo and 40% mixed hard wood chips in their digester. The author has found that mixed cooking of hard-woods and bamboo gives good result.

The quality of hard woods:—At present 70% Salai (*Boswellia serrata* Roxb) and 30% of mixture of the following :

- (a) *Butea monosperma*.
- (b) *Anthocephalus*.
- (c) *Pterocarpus dal Bergioides*.
- (d) *Anogeon sp.*
- (e) *Pterocarpus marsupium*.
- (f) *Soyimida febrifuga*.
- (g) *Elaeodendron sp.*
- (h) *Logerstroemia sp.*
- (i) *Saclopetalum sp.*

at present in the mixture of hard woods received by use.

*Chief Chemist M/s. Bengal Paper Mills Raniganj—Paper (Presented in F.R.I. Symposium on Hardwoods).

The mill receives hard wood, waste from various saw mills in the neighbourhood of Raniganj, mixed hardwoods extracted from Bihar forest, small quantity of mixed hardwood is received from neighbouring farms and forest. The mixed hardwoods received is either completely barked or with very little amount of the bark on the wood. The size of wood logs arrived at the mill vary from 3 inches to 3 feet in diameter and from 2 ft. to 12 ft. in length. The wood log are cut into suitable sizes by a saw mill, so it can be easily fed into the chipper. About 250 tons of mixed hardwoods is chipped per day by the chippers. There are three 5 knives wigger and three 6 knives Voith chippers. Wigger chipper is run by 150 horse power motor and Voith chipper is run by 135 horse power motor. Fines and oversize chips are removed by vibrating screen. Oversize chips are again fed to rechipper. The dust is used in Boilers. The accepted chips are blown by a blower driven by 75 H.P. Motor to wood chips silo. There is wood and bamboo chip silos side by side and each is separate by a wall. The capacity of each silo is to hold 300 tonnes of chips. At the bottom of chips silos parascrews are provided to take required amount of Bamboo chips and mixed hardwood chips. The ratio of bamboo chips and mixed hardwood can be easily adjusted by increasing or decreasing r.p.m. of individual parascrew.

The mixture of bamboo and mixed hardwood chips passes through a strong magnet as to remove any iron pieces present in the chips. Mixed hardwoods and bamboo chips goes to hopper from chip bin. The chips are continuously fed to the chip meter. The feed rate of chips to the digester is adjusted by regulating the speed of the variable speed drive of the chip meter. The amount of chips fed to the digester can be easily calculated from the chip meter speed for the given length of the time.

The chips go into the low-pressure feeder and then to steaming vessel. Here the chips are heated at 1.5 kg. per square centimeter by steam obtained from the first stage flash tank and some amount of fresh steam at 110°C to allow chips moisture content to become more uniform and remove air and gases from the chips. The chips then fall into chip chute where a constant level of liquor is maintained. The excess liquor goes to level tank. The chips are drawn into the high pressure feeder.

The chips are continuously fed to the top of digester with the help of high pressure feeder and liquor circulation pump under pressure. At the top of the digester a top separator is provided to move the chip downwards and keep inside screen cleaned and liquor is drawn through screen and is re-circulated back through the circulation pump and the high pressure feeder.

The required amount of white liquor with the black liquor are added to the digester and chips are completely and uniformly soaked with the cooking liquor in impregnation zone while moving downward to cooking zone. Cooking zone is divided into upper and lower zone. In upper zone the temperature is lower than lower cooking zone. In both zones the liquor is drawn through the screen and passes through indirect heat exchanger to heat liquor to the required temperature and liquor is put back to the centre of the digester at the point just above the strainer plate from where the liquor was drawn.

The cooking process is stopped by addition of wash liquor in the centre of the digester just above extraction plates from where black liquor of high temperature and solid contents is extracted and it goes to flash tank No. 1. The flash steam is used for pre-steaming vessel. The black liquor from flash tank No. 1 goes to flash tank No. 2 and finally it goes to soda recovery plant. At the bottom of the digester weak from filter washer is introduced. It reduces the temperature of the pulp before discharging to avoid the loss in physical strength properties of the pulp due to the mechanical action on the pulp at high temperature. The liquor is circulated by a pump and discharged at the centre of the digester just above the strainer near the bottom of the digester. As liquor travel upwards and the pulp moves downwards the pulp is partially washed inside the digester. The wash liquor being extracted at the wash screen and is re-circulated by a pump gives better and uniform washing of the pulp.

The consistency of the pulp discharged is controlled by a bottom scrapper which moves at a slow speed. The pulp from digester is discharged into allow tank. At a regulated consistency the pulp passes through a sand trap then to hot screening. The accepted stock goes to single brown stock washer and rejects from hot screening is screened by vibrating screen (Jonsson Knotter).

The knots are discharged and refused for repulping. The accepted stock of vibrating screen goes to washer. At washer the unbleached pulp is washed with a low salt cake loss of about 15 kg. per ton. of oven-dry pulp.

The washed unbleached pulp is pumped to unbleached pulp storage tank from where the unbleached pulp is processed in multistage bleaching plant to obtain bleached pulp of 75° G. E. brightness with proper control on pH and chemical addition. The bleached pulp is also passed through centricleaner and Impco centrifugal screen to remove dust and fibres which are not bleached well to make specks free paper. The bleached pulp is either pumped directly to the stock preparation or pumped to bleached pulp storage tank. For old paper machines the pulp is beaten in the conventional beater where the required characteristic are parted to the fibres and required chemicals are added here according to the quality of paper made on the individual paper machine.

Paper machine No. 6, a high speed paper machine of Beloit-Walmsleys design, 120 inches trim produces different varieties of paper at the speeds upto 1,500 feet per minute. This machine has ultra modern stock preparation system supplied by M/s. E. D. Jones Corporation, U.S.A. It may be of interest to note that its six paper machines make six different varieties of paper all the time using the same pulp of 50% mixed hardwoods and 50% bamboo fibres composition. Rag and other pulps are mixed with the mill pulp to make special grade paper.

The author is of opinion that any species of hardwood can be used for pulping provided the wood is without the following defects:—

- (a) woodlogs are not having too many **knots**.
- (b) heart wood does not contain high percentage of dark colouring matter, **resins and tannin**.
- (c) wood fibres do not have **very poor zero** tensile strength.
- (d) may not be difficult to be chipped wood species like tamarind (Tamrix Indica).

- (e) is not of very **dark colour** and consists of the matters which causes or give rise to troubles in cooking and bleaching.

The following precautions are being taken at the Bengal Paper Mill for selecting wood log for cooking :

- (a) wood logs are to be free from bark.
- (b) wood logs are without knots as much as possible.
- (c) wood logs are not eaten by fungus, borer and insect.
- (d) wood logs are not very much affected by weather. By keeping pulp wood logs for a long period in open sun and rain, get deteriorated wood log is very poor in physical strength properties. The best solution is to use wood logs soon after cutting.
- (e) wood logs are not eaten by fungus, borer etc. It gives two advantages. Freshly cut wood is high in moisture content help in better chipping and cooking and also gives pulp of better strength as compared to seasoned wood.
- (f) the central portion of logs should not be hallow due to insects etc. and too dark in colour.

The Bengal Paper Mill is **finding hard to get desired quantity and quality** pulp wood and would suggest a practical approach to utilise existing hardwood forest for obtaining constant pulp wood supply from the same area. As initial cutting proceeds, the entire area is cleared off. Seedling stock of fast growing hardwood like Eucalyptus, Authocephalus, Kadamba, Paper mulbury (Broussonetia Papyrifera) are planted and protected for two years. It can be said with confidence that carefully planned and organised replanting of a particular species will prove successful to meet shortage of cellulosic raw material for the paper industries in India.

Effect of hard wood fibres in paper furnish. Hardwood fibres are considerably less in length than soft wood. In soft wood there are two kinds of fibres, the spring fibres with thin walls and the

autumn fibres with thick walls. The presence of the two kinds of fibres in soft woods is one of the reasons for the superiority of these pulp over hard wood pulps probably because of a better interweaving during sheet formation. Recent studies show that the fibre length is not only the characteristic for good paper making pulp. The quality of pulp may be judged from these qualities :

- (a) Fibre length.
- (b) Width of the fibre.
- (c) Cell wall thickness.
- (d) Lumen width.
- (e) Viscosity of pulp and intrinsic fibre strength.

Hard woods can be used for quality papers with only small percentage of long fibre pulp to obtain good folding endurance, tensile strength and tear factor.

% hardwoods can be adjusted with other long fibre material as to obtain the desired effect and

properties in paper and paper board. Tag boards of satisfactory properties and dimension stability are being manufacture at the Bengal Paper Mill with the mixture of hard woods and bamboo. No doubt it is very essential to have rigid control on technical process to meet the challenge of competitive market growing in the paper market and to produce the paper of high quality.

It is highly felt that of lot fundamental research work is to be carried out to study Indian hardwood for its development. The technique adopted of high consistency beating of hardwood fibres in Japan is highly encouraging to utilise more and more quantity of hardwood in pulp and paper industries. In tropical region and particularly during rainy period, the rate of hardwood deterioration from stain decay and insects is extra ordinary high. Certain chemical sprays or dip to control the insect is found to be expensive. It is not possible to have huge water ponds to store the woods, so some studies are to be made to store the pulp wood without deterioration where the wood can not be used soon after cutting.

Paper mills are more inclined to use hardwood provided the proper quality of mixed hardwoods are available to them at economical price and sufficient quantity for a number of years.