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D02747

Distr.
LIMITED

ID/WG.102/7
24 August 1971

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Expert Group Meeting
on Pulp and Paper
Vienna, 13 - 17 September 1971

PRACTICAL EXPERIENCES IN THE USE OF MIXED TROPICAL HARD-WOODS FOR THE PRODUCTION OF PULP AND PAPER 1/

by
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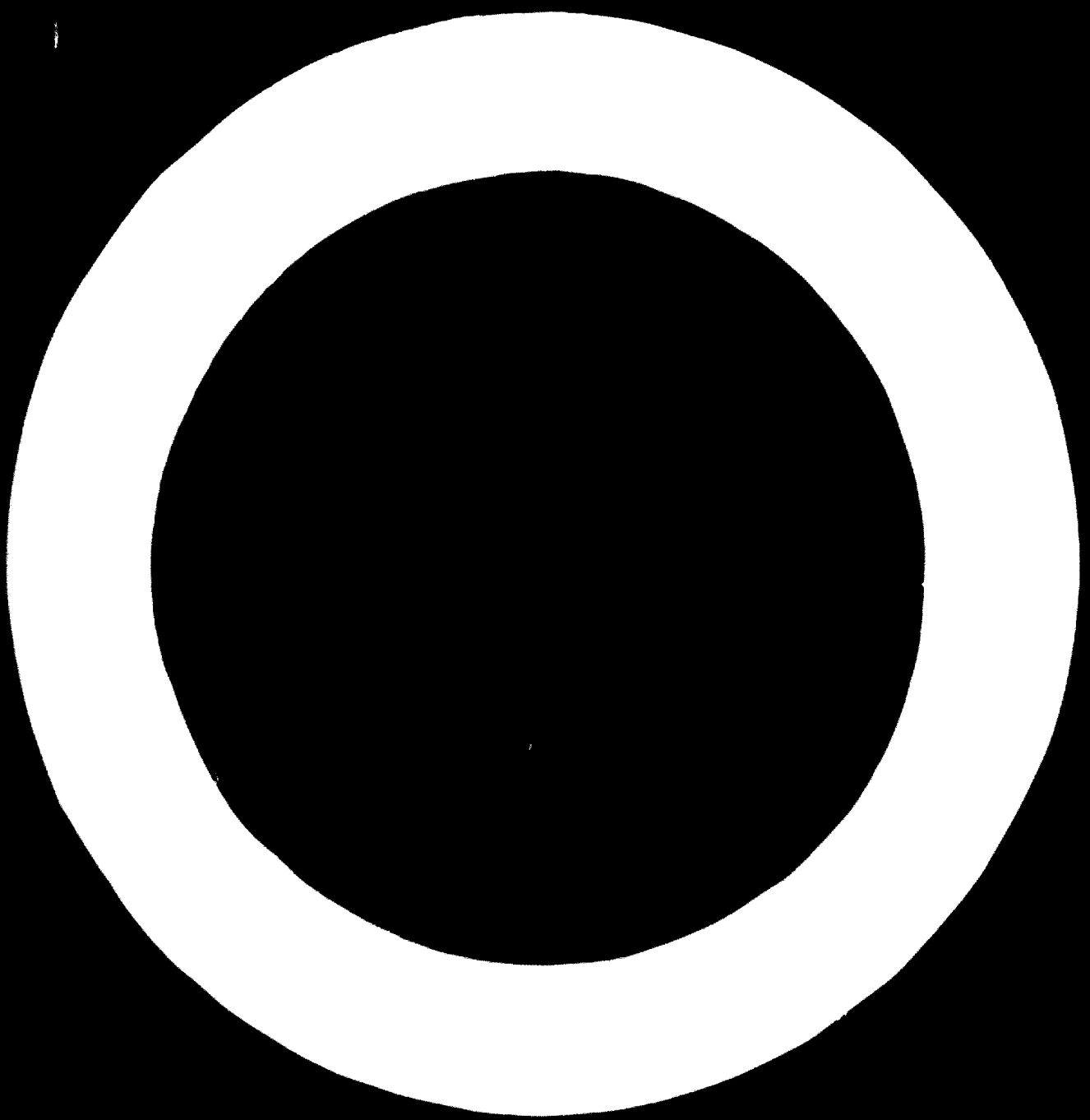


Bamboo, which grows in the forests are some of the main raw materials used for the production of pulp and paper in India. Some of these raw materials, especially bamboo, are gradually getting in short supply due to more and more production of paper in this country. Soft woods could replace or supplement bamboo, but due to transport difficulties it has not been possible to apply to this raw material. Star Paper Mills at Saharanpur used some pine wood and manufactured very good quality kraft paper. Unsatisfactory supplies of this wood exhausted very soon. Around the year 1961 the Bengal Paper Mills Co. Ltd., Amlagarh in West Bengal started using mixed tropical hard woods as supplementary raw material to bamboo, which was getting in short supply, to meet the requirement of the pulp demand after the installation of one high speed writing and printing paper machine. Mixed tropical hard woods were procured after logging from the nearby forests. It was chipped in the chippers installed for chipping bamboo. From the beginning, chips of hard woods and bamboo were mixed and cooked in conventional batch digesters. The results were found to be encouraging with 10% hard woods. Gradually the percentage of hard woods was increased and finally it was taken up to 25%. The quality of the papers manufactured with this furnish was satisfactory except that the folding endurance was low. Due to weak pulp, high ash percentage could not be maintained. The look through of the paper was better even with less power consumption in the stock preparation section.

Satisfied with the results of the performance of the mixed tropical hard woods, the management decided to go in for Kamyr continuous digester with Hi Heat diffusion washing system. The pilot plant trials at the Kamyrs in Sweden indicated that mixed tropical hard woods could be used up to 50% along with bamboo and the final bleached pulp could be of 80° GE brightness with satisfactory physical strength properties. In this digester the total cooking and washing cycle is 8 hours. Out of this, 3 hours are for impregnation, 2 hours for cooking and 3 hours for washing. The cooking chemicals used are 16 - 18% as NaOH to get pulp of 16 + 1% K. Number. Johnson Knotter rejects are 2.5% on the basis of raw material. In this digester, high heat diffusion washing of the pulp is carried out. About 60% of the washing is done in the digester itself and the rest is done on a single drum two stage washer. The washing losses as Sodium Sulphate are about 15 - 16 kg. per ton of pulp. The dilution factor is 2.5%. Steam consumption per ton of pulp is 1.25 tons. About 9 - 10 M^3,

Black Liquor per ton of pulp at 17 - 16%TW is available from the digester. The organic and inorganic ratio in the Black Liquor is 56% and 44% respectively. The acid solubles are about 0.03%. Normally the Copper Number of the unbleached pulp is 0.6 to 0.65 and the cuprammonius viscosity is 26 - 28 cps.

For a daily production of 150 tons of pulp, it was necessary to make arrangements to procure about 450 tons of mixed tropical hard woods. To achieve this, the mill had to depend on a large number of mixed tropical hard woods species. The woods logs received are of diameters varying from three to eighteen inches and lengths from three feet to ten feet.

The bigger logs are sawn in saw mills to six inches diameter and five feet length. The smaller logs are, however, fed directly to the chippers. To overcome the saw mill losses, the management is making arrangements to import one special chipper of bigger capacity to deal with wood logs of up to eighteen inches diameter.

Some of the main wood species used for pulping are given below:-

1. Boxwellia Serrata
2. Eucalyptus sp.
3. Accacia Auriculiformis
4. Butea monosperma
5. Albizzia procera
6. Anogeissus latifolia
7. Shorea robusta
8. Mangifera indica
9. Anthocephalus cadamba
10. Casuarina equisetifolia
11. Diospyros melanoxylon
12. Terminalia tomentosa
13. Tamorindus indica
14. Madhuca sp.

NOTE: The fibre morphology of mixed hard woods varies too much from species to species. In certain species even the short fibres give good strength properties.

Different wood species behave differently in sawing and chipping. Wood species like casurina and quistlifolia, Diespyros melanoxylon, Terminalia tomentosa are very hard to saw and chip. These are more difficult to chip when they are dry. With 30% moisture contents, they give less trouble in chipping and sawing. It is observed that chips containing high moisture require less chemicals in pulping. The chip size obtained is also uniform with less percentage of over-sized and under-sized chips. In general, the chip size distribution of mixed tropical hard woods is as follows:-

Retained 1½" x 1" sq. (over size)	2.5%
Chips between 1½" x 1½" sq. and 1" x 1"	20.5%
Chips between 1" x 1" sq. and 3/4" x 3/4"	24.5%
Chips between 3/4" x 3/4" sq. and ½" x ½"	29.6%
Chips between ½" x ½" sq. and 3/8" x 3/8"	9.7%
Chips between 3/8" x 3/8" sq. and ¼" x ¼"	5.6%
Passing through ¼" x ¼" sq. (dust)	4.6%

To obtain chips of ½" x ½" to 1" x 1", the oversized chips and undersized chips (slivers, dust and pin chips) are separated in RPM chip screen. The oversized chips are re-chipped in the re-chippers and are recycled in the chip screen. The dust and pin chips are thrown out.

The bamboo chips and mixed hard woods chips are stored separately in chip silos. They are drawn on a belt conveyor with the help of para screws. Iron pieces are separated by a magnetic separator. The mixed chips are blown to the chip bin and are fed continuously at a known rate to the Kamyr digester. The unbleached pulp is blown to Blow Tank and is then passed through Sund Impco Hot Screen of 3 mm holes. The rejects are fed back to the chip bin. The accepted pulp is washed on a two stage vacuum washer with counter current washing system. The washed unbleached pulp is pumped to high density storage tower. It is diluted and then fed to a four stage bleaching plant. The bleached pulp obtained is of 1.0 copper Number and 12 - 14 cps viscosity. The brightness of the bleached pulp is 73, 74° GE. With 35 - 40% mixture of mixed hard woods, the chlorine demand is about 12.0%. Out of this 50.0% is used as chlorine gas in chlorination stage and rest 50.0% as Hypochlorite in both the D/Eo stages. A few laboratory results showing the physical strength properties of the washed unbleached pulp and bleached pulp are given below:-

TABLE I

UNBLEACHED PULP

Sl. No.	°SR	GSM	Breaking Length (M)	Burst Factor	Double Fold	Tear Factor
1.	45	65	7179	40.0	36	61.5
2.	40	66	6616	39.3	69	60.6
3.	41	69	6600	43.0	60	138.0
4.	50	66	6767	43.0	80	145.0
5.	50	64	7198	46.0	57	122.0
6.	45	60	7082	42.0	45	155.0
7.	45	62	7634	48.0	41	65.0

TABLE II

BLEACHED PULP

Sl. No.	Beating time (Hrs.)	°SR	CSF	Breaking length (metres)	Burst Factor	Tear Factor	Double Fold
1.	30	42	65	5641	32.3	49.2	13
2.	35	42	63	6560	38.0	56.0	4
3.	40	40	70	6400	39.0	115.0	22
4.	40	45	60	6533	37.0	123.0	8
5.	45	40	63	6200	41.0	133.0	37
6.	55	35	61	6250	33.0	85.0	13
7.	40	42	70	7137	45.0	126.0	26
8.	50	45	65	6656	43.0	116.0	29

The above results show that the physical strength properties of the pulp with 35 - 40% mixed tropical hard woods and 60 -65% bamboo are satisfactory for the manufacturing of writing and printing papers. This mill is making quite a good range of writing, printing and speciality papers, such as Air Mails, Manifold, Bonds, Offset printings, Duplicating papers, Backing sheets, Data Processing tabulating cards and base paper for decorative laminates.

TABLE III

PHYSICAL STRENGTH PROPERTIES OF SOME NORMAL GRADES OF PAPERS ARE GIVEN BELOW

Sl. No.	Paper	°SR	Breaking length (metres)	Burst Factor	Tear Factor	Double Fold	Ash %
1.	White printing	60	4032	14	53	3	12.0
2.	White wove	58	4244	15	56	4	12.0
3.	Fine Litho printing	65	4189	22	52	4	16.5
4.	White base paper coating	65	3800	21	95	10	5.0
5.	White backing sheet	90	4368	22	93	10	5.0

So far the process of pulping mixed hard woods as is being followed in the Bengal Paper Mills Co. Ltd, Raniganji (India) has been briefly outlined. Since this mill has used mixed hard woods up to 40%, some very interesting observations have been made and this article will not be complete unless they are described.

1. Storing

Some of the species are highly susceptible to fungus and insect attacks. It is very difficult to store these species in huge piles for a longer period. Even spraying of insecticides does not help. As such, arrangements should be made to use away the stocks on the first come, first used basis.

The quality with respect to pulping differs according to species. If possible different species should be stored separately and used in certain proportion according to the qualities of paper manufactured. Supervision in the wood storage yard is very important as otherwise if wood with bark or decayed wood logs are allowed to pass unnoticed, paper quality will be effected.

2. Chipping

Mixed tropical hard woods are difficult to chip. As such these should be cut in proper sizes with respect to length and diameter before they are fed to the chippers. Crooked shaped logs should be segregated as they will jam the chippers and affect production. Selection of chipper knives and their setting is of great importance to get uniform sized chips with less slivers and dust.

3. Cooking

When cooked in conventional batch digesters it is better to cook mixed tropical hard woods separately. It will have the advantage of better screening and bleaching. With mixed cooking bamboo fibre is most likely to get more drastic treatment in order to cook mixed hard woods suitably. However, experience has shown that in the Kamyr continuous digesters mixed cooking of bamboo and hard woods has given very satisfactory results. It is further claimed that cooking of mixed hard woods in the improved vapour phase Kamyr digester will result in getting more uniform pulp and very good physical strength properties. It will be of further advantage if bamboo and hard woods chips are washed before cooking. This will result in removal of Silica and fines and will help better penetration of the cooking liquor. It is also desired that 25.0% sulphidity should be maintained in the cooking liquor. Presence of mixed hard woods chips help the bamboo chips to flow better. They also give better packing of chips in the digesters.

4. Washing and Screening

So far as washing is concerned, mixed hard woods do not pose any problem. In screening, however, a very careful control is necessary. The wood species being too many and also old and new are not cooked uniformly. This non-uniform cooking results in more rejects in screening and pulp remains shivy even after bleaching. It is, therefore, suggested that some sort of defibrator be installed before the hot screens to open the semi cooked fibres bundles.

5. Bleaching

Even before passing the washed unbleached pulp to the multi-stage bleaching plant, the pulp may also be passed through a disc refiner which will further open out the bundles of fibre. This opening will result in better bleaching with less chlorine consumption and will give gain in yield. The bleaching should be done in a four-stage bleaching plant, consisting of chlorination, caustic extraction, first hypochlorite and then second hypochlorite stages. During bleaching rigid control of PH and temperature should be followed so as to avoid degradation of the fibres.

6. Final Screening and Centricleaning

This stage is equally important so as to obtain speck free bleached pulp.

7. Stock preparation

This is a very important stage as any omission or negligence in this operation will mar the entire efforts taken in cooking and bleaching to produce satisfactory pulp. Experience has taught that first refining should be done at consistency as high as 6.0%. Disc refines with floating discs are most suitable. Further refining should be done in conventional refiners such as fibre masters with 9 mm thickness bars. In Japan, where very good qualities of papers and boards are made from hard woods, they make use of "fibre fractionators". This separates the long, medium and the fines. While long and medium fibres are given suitable refining action, the fines are directly blended in the final stock chest. With this arrangement of stock preparation, paper machines can be run on higher and higher speeds and more and more loading can be used to impart better printing surface.

In the absence of "fibre fractionator" refining at high consistency and addition of certain Paster additives, such as Diacol and wet strength resins will enable to run paper machines at higher speeds up to 1700 feet per minute on 4 gms substance and reasonable ash contents.

8. Paper Machine

There has never been any trouble with respect to sizing in the mixed hard woods furnish. With the adjustment of table rolls, good sheet formation can be obtained. At times, there is trouble of press picking. It is usually overcome by giving 0.1 to 0.5% wet strength resins solution in the machine chests. This will enable the sheet to pass through the presses as its wet strength is increased. Dripping of 5.0% solution of Tamol N O P (a BASF product) on the doctor of the first press roll to eliminate press picking. In case paper machines are to be run on higher speeds (say) 1200 - 1500 feet per minute, it is desirable to have suction sheet pick up arrangement on the paper machines.

The sheet formation is generally better when hard wood is present in the furnish. Refining power required is less compared to 100% bamboo furnish. The only disadvantage is that the rollmark endurance is low. Sometimes, there are complaints of "fluff" while printing on an offset press. This complaint can also be overcome to a great extent by giving a thin coating of starch or carboxyl methyl cellulose on the size press.

Generally the finish obtained is similar to the papers made with conventional furnishes. Colour reversion is of the same nature as in papers made with bamboo.

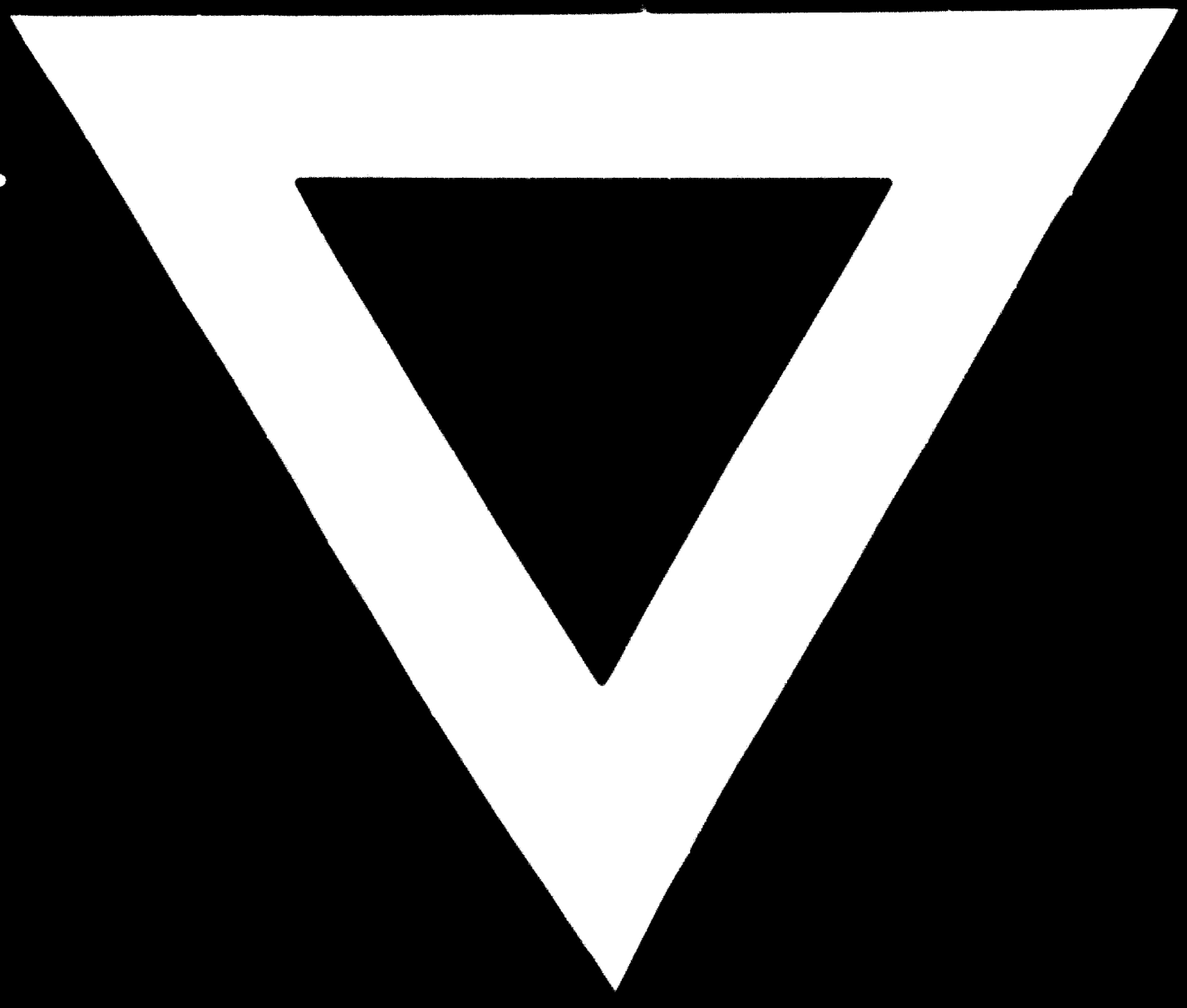
9. Soda Recovery

No special difference has been observed in the behaviour of Black Liquor with 35 - 40% mixed hard woods. It is, however, claimed that burning of Black Liquor is likely to be better when Eucalyptus wood is used for pulping.

Conclusion

Mixed tropical hard wood is a progressive raw material for countries where the conventional raw materials are in short supply or are getting in short supply gradually. The only thing is that stress should be given on the selection of species. Requirement of each paper mill should be studied and supply made accordingly.

Plantation of old and new species should be taken up both by the Government and the Industry so that the vanishing species are regrown and fresh species are available in regular supplies. Arrangements for debarking should be made in the paper mills as in the forests it cannot be done properly. Little negligence in this respect will make the entire efforts of pulping and bleaching null and void and rejects will be heavy. In India if more and more mixed tropical hard woods are to be used, adequate machinery for cooking, screening and refining should be procured either from abroad or made indigenously. It will be difficult to use high percentage of mixed tropical hard woods on the conventional pulp and paper making machines. Best results will be obtained if proper equipment to deal with hard woods for cooking, screening and bleaching stock preparation and paper machines is made available.



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