Paper Making Raw-Material-Techno Economics

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"In this paper a brief analysis of raw material costs, size of units, economics of market pulp mills are reviewed. Some digression into directions for research, Forestry policy and efforts to increase yield through monosulphite pulping, has been made. A brief review of the existing experience of hard woods in the furnish is also incidentally given.

Intr oduction

An apple does not choose a farmer. But in the Indian Paper Industry, it is a reverse case. Raw material position fixes the limit to output and type of paper to be made.

The per capita consumption of paper in India is around 1.5 Kg. and this means that every Indian spends less than Rs. 4/- in finished stationery or other form per year. The increase in paper price is only marginal and paper is a very cheap commodity. In India further a piece of paper is reused several times before it is thrown off. This is why waste paper is not easy to collect for pulping purposes.

When we tap a mineral at two places few miles apart, we get almost the same composition while one tree is different from another and branches within the same tree also differ from each other. It is possible to produce an aluminium foil with greater uniformity than paper. Obviously it is not because the paper technologist is any less competent. With higher investment and chemical inputs, it is possible to make it more uniform. But as it is desired to make paper cheaper, efforts of paper technologists are oriented in this direction.

For the year 1968-69 the raw material cost per tonne of paper varied from Rs. 486/- to Rs. 205/- in different mills. The variation is largely explained by locational factors, including the control over the raw material base, the price at which raw material is available and the pulpable material required for one tonne of paper, which, in turn, depends on the process used and its efficiency. The general policy of the mills should be to procure the least cost raw materials and mix them in proportions estimated to yield maximum profit.

The paper Industry suffers from two major drawbacks—one is high investment requirement and second is the sensitivity to raw materials. Recent efforts on computerisation have only resulted in putting only 45 out of 200 variables in a closed circuit which shows that paper making is still an art.

Raw Material

At present raw materials being used by the Pulp and Paper Industry are:

(i) Bamboo	..	67%
(ii) Wood Pulp	..	18%
(iii) Grasses	..	7%
(iv) Bagasse	..	3%
(v) Others	..	5%

What a Paper Mill wants from a raw material among other things are as follows:

(a) *Freight*: Freight cost should be low. This depends on bulk density, distance of haulage. This also depends on the terrain and nature of transportation. In India, river transportation is negligible. Percentage-wise raw material costs per tonne of paper are rising and by present trends will rise steeper. We would see that it should be used most economically.

(b) *Pulp Yield*: This means the quantity of pulp produced from a given amount of raw material. Indian Industry has been even more conservative to changing the pulping techniques. High yield pulping processes have not been studied in detail with respect to our raw materials. We are still depending entirely on the sulphate pulping technique.

Some research work has been done by West Coast Paper Mill and Andhra Pradesh Paper Mills on the monosulphite pulping process for bamboo in particular.

It is not within the purview of this paper to go into the actual technique. Only salient features are given. Pulps in high yields consistent

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with good strength characteristics were obtained from two Indian bamboos, viz., Bambusa arundinacea and Dendrocalamus strictus, by using sodium sulphite with sulphate green liquor as the cooking chemicals. Under optimum conditions of monosulphite pulping, the unbleached pulp yield was ranging from 69 to 71% and the bleached pulp yield from 58 to 60%. For the same Kappa number of pulps these yields are 10% higher than kraft pulping.

Unbleached monosulphite pulps of 68-70% yield were as strong as kraft pulps of 60%. The bleached monosulphite pulps have bulk and opacity. Monosulphite pulps were easily bleachable by the conventional bleaching sequence. The Bleachability of these pulps was better than kraft pulps.

Unbleached and bleached pulps are characterised by high ash and silica contents—over 90% of the total silica present in bamboo was retained in monosulphite pulps compared to 30-40% retained in kraft pulps. This increased retention of silica in monosulphite pulps also contributes to increase in pulp yields to the extent of 2.5% on raw material. Consequently, the liquors obtained from monosulphite cooking will be low in silica content with consequent reduction in recovery problems.

The Indian problem is magnified by the fact that most of the Mills try to cover a wide variety of Papers like Kraft Paper, Writing and Printing Paper, Speciality Papers. But the pulping process continues to be the same. A Mill producing only Kraft Paper can adopt process conditions to give hard cook pulp with higher yield and admix with pulp from high yield pulping processes. A Mill producing quality bleached paper can go in for soft cooked pulp. This type of segregation not only conserves raw material and reduces costs besides giving better uniformity to the product.

It will be of great advantage to classify the pulp into fractions based on the length of fibres and give separate refining treatments. This will result in considerable reduction of power and fibre loss. The effect of refining with lava Rotors on bamboo pulp needs investigation. In general, bamboo pulp refining in view of high fibre length to diameter ratio needs further study. Fractionators are being used in Sweden.

For instance, high yield monosulphite pulp after fibre fractionation resulted in separation of the parenchyma cells and beating, further developed grease-proof properties.

Investment

It has been estimated by the Planning Commission that the requirement of newsprint, writing and printing paper, rayon etc. would be nearly 4 million tonnes in 1985. The economical size of units will have to be 150-200 tonnes per day and in a few years time this would be 300-500 tonnes per day in location where adequate raw materials are available[3].

Size (Tonnes per day)	Cost of raw material per tonne of paper (Rs)
100	324
200	263
250	258
Expansion	278

The economic size of paper mills today in the more industrialised countries is around 750 tonnes per day or more. Even in lesser industrialised countries the minimum economic size is 300 tonnes per day. "According to the report of the Pre-Investment Survey Group (FAO), the manufacturing cost per tonne of printing and writing paper would fall from Rs. 1,489/- in a 100 tonne per day plant to Rs. 1,238/- in a 200-tonnes per day plant and further to Rs. 1,104/- in a 300-tonnes per day plant."

Integrated paper plants of 200 to 300 tonnes per day or over, need to be set up. This may be either by setting up new plants of such capacity or by allowing some of the existing plants to expand to this capacity. But as the capacity increases the load for raw material increases and an economic optimum may vary from area to area. So there would be an appreciable number of small units. These mills may be forced to confine themselves to producing only special paper which would any way be required in small quantities only. There is a possibility also of reducing costs by being near to markets and by doing partial converting operations like making waterproofing paper or corrugating boards etc.

Market Pulp Mills:

It has been a practice so far to set up Pulp Mills in a place where raw materials are available in plenty and transport pulp to Paper Mills. This practice is also ceasing in Sweden and Canada but for export pulp. Japan, the third largest paper producing country, does not import pulp but only wood or wood chips. The economics of this system needs a detailed study. Here, we are limiting ourselves to an overall analysis and

the problems faced with regards to the quality.

The main advantage is cheaper transport costs but the economy of such units have to be dispassionately viewed on an overall basis.

An investment analysis made recently of an Integrated Pulp & Paper Mill is given here below:

Section	Total cost (%)
Pulp Mill ..	26
Paper Mill ..	22
Chemical Mill ..	22
Miscellaneous including utilities and services ..	30

In case of Pulp Mill the investment includes Pulp drying unit in place of conventional Paper Machine. So the difference in investment between integrated Mill and Pulp Mill will be hardly 20%. (22% less partial utilities and services cost plus pulp machine cost).

The freight cost difference between raw material and finished pulp from Pulp Mill will have to offset the interest on the additional investment and operating costs of a Paper Mill. If this is not so, the cost of Pulp will not be economical.

The strength properties of dried pulp on repulping will come down. In case off grade pulp an integrated Mill will have the facility to manufacture ordinary variety of paper, which a pulp mill cannot.

Future Market Pulp Mill would have to produce high grade long fibred pulp in particular. This can be done particularly in the Himalayan region where Pine, Douglas Fir etc. are available. This would help in producing speciality papers in full or partial furnish in smaller or may be even bigger mills. Even here the capacity of the Pulp Mills will have to be large to reach the break even point. The use of Hard Woods as a constituent in market pulp will make the pulp weak and is not desirable. Another way would be for Paper Mills and Rayon Grade Pulp Mills favourably located to produce some extra pulp and sell it to smaller Paper Mills not so fortunately located.

Forestry

In any important paper producing country the industry plays an active role in regenerating the raw material source. There is no reason why Indian Paper Mills should not follow the same practice. The World Bank Mission which visited India to investigate the prospects of plantation programme have suggested that mills with capacities over 100 tonnes per day may be in a position to run plantations economically, though they expressed preference for still larger units of 300 tonnes per day capacity, so as to achieve economics of scale.

It is necessary that some concrete steps as recommended below should be taken up and have a systematic plantation forestry with proper inputs.

1. Paper Mills may be permitted to develop their own plantations, on a long term lease.
2. There should be a development rebate on forest investment as in Australia.
3. Government should outline the nature of expansion for each paper mill for the next 25 years in order that they can plan their forestry programmes, and may insist on paper mills to keep to certain broad objectives.
4. A central organisation as suggested by Mr. V. K. Seth to deal with all aspects of Pulp and Paper Industry (like the one in Italy) should be formed immediately.

Cost:

Felling cost is likely to increase for bamboo as the bamboo clump is not clear felled and bamboo yields per acre being lower, the area needed for extraction is very vast.

Plantations:

The other way to reduce the raw material lead is to develop annual crops. Some plantations on a systematic scale have been done for Sesbania Grandiflora. The outstanding feature is its rapid rate of growth and its light colour. Pinus Caribea plantations are now being tried at some places and if successful it can change the pattern of the growth of the Paper Industry in India.

Sal (Shorea Robusta) can be grown both for pulping as well as for industrial timber but not much data on the pulping of this wood is available.

Hardwood:

It is necessary that they should be used in the same proportion as they occur in the forests, so that the process conditions can be optimised.

Barking is mostly being done today in the forest. But it is anticipated 50% would have to be done at site, in the near future.

It is necessary that we develop the concept of whole log utilisation and in such a case use of bark, heartwood etc. would be complete and make the unit integrated and economic.

It is desirable to remove the heartwood particularly in some species to improve the quality of pulp. The heartwood can be used as timber.

Some species produce oversize chips. The productivity of batch digesters does not change appreciably and pulping conditions remains more or less the same. The pulps are easily bleachable. Upto 20%, addition in the furnish does not affect the strength of paper. However, separate cooking is being adopted in some Mills. Chlorine dioxide bleaching is likely to become more popular.

Directions for Research:

The Pulp & Paper Industry must among other things direct itself to intensify research activities in the following directions.

(1) Production of low cost chemical additives to improve the strength and quality of paper so that raw materials presently considered inferior can be utilised in a higher proportion.

(2) Additives should also be developed for retention of fines and thereby increase of pulp yield. In Japanese mills only 0.5% fibre loss is reported.

(3) There is also a need as suggested by Mr. V.K. Seth for grading hard woods on the basis of species and sizes. But for a few species, most of them are generally pulpable. F.R.I. could help in forming such a compendium.

(4) Research should also be done on density of wood as against yield so that trees are cut according to the desired age, etc. Research on pulping of various hardwoods after removal of heartwood would be beneficial.

Conclusion:

While it might be too much to say that the present drought situation has been caused by the depletion of forests however, such a situation may arise in the near future if proper steps are not taken.

Forestry does not seem to have the deserved importance in the broad spectrum of national goals. May we suggest that the Government put some political expediency into the wood and woods!

Raw Material Cost Breakup

Exploitation rates for pulpwood:

Felling, billetting, collection and stacking	35%
Dibarking Charges	35%
Loading Charges	10%
Unloading Charges	4%
Supervision	16%

Exploitation of bamboo:

Felling and Handling	30%
Transportation to a Central Place and Rebundling	12%
Cost of string	10%
Loading on the truck	4.5%
Sundry expenses in forest	4%
Cleaning of Clumps	8%
Unloading from the truck to the yard	1.5%
Feeding to Chippers	10%
Supervision	20%

Bamboo costs in this particular case is at least 25% costlier, based on equal moisture basis.

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