

# Search for a Suitable Long Fibre Raw Material for use with Agricultural Residues & Tropical Hardwoods

**T. JEYASINGAM**

## 1. Introduction

More than 90% of the world's pulp production has been mainly centred in six countries—Canada, Finland, Norway, Sweden, United States and U.S.S.R. This is mainly due to the abundance of coniferous woods in these areas. Coniferous woods have been traditionally recognized as a raw material for paper making in view of the following advantages :—

- (a) The versatility of this fibrous material to make diversified grades of paper ranging from the cheapest newsprint to the finest grade of tissue.
- (b) Simplicity of extraction and transportation on account of easy accessibility.
- (c) A satisfactory pulp yield.
- (d) The suitability of the raw material for pulping at an economic level of operation.
- (e) Homogeneity in wood quality.

As a result of coniferous woods dominating as a pulping material most of the countries are forced to

depend upon North America and Northern Europe for their supply of wood pulp. During the past few years it has been realised that the world is moving towards a shortage of this traditional raw material. It is therefore now recognized that the entire world cannot depend on these few countries which are favoured with the fast dwindling stock of coniferous stands.

In addition it is anticipated the countries which are presently exporting wood pulp, newsprint, etc., will have to slow down the pace of expansion due to stringent pollution laws. It will therefore be necessary for developing countries to aim at self-sufficiency in pulp and paper production.

In developing the paper industry in this region towards achieving self-reliance, the following factors will have to be taken into consideration:—

- (a) The demand for paper in developing countries has been increasing due to gradual industrialization and the continuing rise in the level of literacy. The shortage of indigenous raw materials to meet this demand will continue unless steps are taken to develop sufficient raw materials to satisfy the paper industry.

- (b) The available raw materials in the region do not meet the standard of coniferous in respect of versatility for use in diversified range of paper grades, economy of production and quality. In consequence, a certain proportion of imported wood pulp is still being used by the paper industry. This situation cannot continue in view of foreign exchange difficulties.

- (c) Certain grades of paper are being imported due to the difficulties experienced in obtaining suitable fibrous raw materials to manufacture these grades resulting in a further drain in foreign exchange.

## 2. Fibrous Raw Materials Currently Available in the Region (India and Ceylon) for the Paper Industry

The objective of this paper is to identify—

- (a) the fibrous raw material that are presently available for the paper industry;
- (b) the technological and economic limitation of indigenous raw materials;

---

**T. JEYASINGAM**

**General Manager (Operation and Development) Eastern Paper Mills Corporation, Colombo, Ceylon.**

- (c) the alternative fibrous raw materials that could be developed in view of these limitations.

The three main sources of raw materials for the paper industry in the region (India and Ceylon) are:—

- (a) Agricultural Residues
- (b) Hardwoods
- (c) Bamboo

The problems connected with the use of these materials are discussed under three major classifications of paper grades i.e. writings and printings, kraft grades and newsprint.

Since the countries under consideration are located in the tropics and are highly populated areas, the availability of raw materials in the form of agricultural residues is on the increase. This is on account of intense agricultural development to make these countries self-sufficient in food supply.

### **3. Manufacture of Writings and Printings From Indigenous Raw Materials**

#### **3.1 Rice Straw**

In addition to India and Ceylon, rice straw is being used in other countries such as U.A.R., Indonesia, Pakistan, Thailand and Italy for the production of paper. Rice straw contains contraries such as husks, leaves and remnants of grains with the result the proper stem represents hardly 50% by weight. Owing to a large number of parenchyma cells, the fibrous pulp obtained from this raw material is characterized by low drainage. Rice straw compared with other cereal straws contains a high percentage of ash with the result

there are problems connected with the recovery of chemicals. Although rice straw has been found suitable for the manufacture of writings and printings it has certain disadvantages. Due to the fibre characteristics of the pulp approximately 30% long fibre has to be used for obtaining optimum runnability conditions on the paper machine. Also transport and storage costs are high on account of the bulky nature of the raw material. Pulping costs are higher due to low yield and difficulty in recovering chemicals.

#### **3.2 Bagasse**

Bagasse is an important raw material for the paper industry in developing countries in view of its suitability for pulp production. As a result of the advances made in pulping technology, many different grades of paper varying from corrugating medium, wrapping grades, grease proof to writings and printings are being produced from bagasse. It has certain desired characteristics of its own which are not found in wood pulp and for this reason, it is being blended to great advantage with long fibre wood pulp to make a diversified range of grades that were traditionally made entirely with wood pulp.

Bagasse has a distinct advantage over other agricultural residues in that it involves no great problem of collection. The cost of collecting, crushing and cleaning the material are borne by sugar mills.

Although bagasse is highly suitable for the production of writings and printings, the limiting factor in most of the cases is an alternative fuel for the sugar industry as it is

the practice to use bagasse as a boiler fuel. For this reason bagasse may not be available for the paper industry as a raw material unless cheaper fuel in the form of coal or oil is available for the sugar industry. Although certain mills in India are able to use bagasse as a raw material, it may not be practicable for a country like Ceylon which depends on imported fuel. Even in the case of India, due to the difficulties of obtaining bagasse, only one mill is still using it as a major raw material for the industry. Some of the mills which were originally designed for the use of bagasse have switched over to the use of bamboo and tropical hardwoods.

#### **3.3 Hardwoods**

Tropical regions like India and Ceylon are favoured with an abundance of mixed, natural broad leaved forests. The pulp and paper industry in India has made rapid progress during the past few years in using this raw material. Indian mills faced with the shortage of bamboo supply were compelled by necessity to use hardwoods as one of the raw materials. As a result of the progress made by Indian technologists in pulping mixed tropical hardwoods, this material will continue to play an important role in the attempt to bridge the gap between the demand and the supply of fibrous materials for the paper industry.

Most of the mills are using hardwoods to the extent of 40% blended with 60% bamboo pulp for writings and printings. In view of the heterogeneity of hardwoods there are technological problems connected with the quality and yield of pulp. In the manufacture of bleached grades

there are difficulties in acquiring the required brightness and cleanliness.

For quality reasons and for runnability on the machine the use of hardwoods for writings and printings would largely depend on the availability of bamboo or any other long fibred material. Indian mills are facing a shortage of bamboo. In Ceylon where bamboo is not available the use of hardwood as a fibrous material will depend upon the availability of imported long fibre wood pulp.

### **3.4 Bamboo**

Bamboo is not a new raw material for the paper industry. It is being presently used both in India and Pakistan for the manufacture of pulp and paper. For tropical areas it is a very promising potential long fibre material.

In 1924, there were only 9 mills in India and the annual production capacity was about 33,000 tons. The raw materials used by these mills were rags, wood cuttings, waste paper, Sabai grass and imported wood pulp. On account of the incentive given by the Indian Government, by its 'Bamboo Paper Production Act' of 1925, to promote the growth of Bamboo, there has been a steady increase in the use of this raw material for paper making. At present there are 57 mills with a total production capacity of 730,000 tons and 67% of the raw material being used is bamboo, the rest being wood pulp 18%, grasses 7%, bagasse 3% and other materials 5%.

Bamboo being a long fibred material has been found suitable for blending with short fibred pulp such

as tropical hardwoods as explained before. For mills that use agricultural residues such as rice straw, this would be an ideal long fibred material. In Ceylon, where rice straw is being utilized bamboo pulp could save foreign exchange by replacing imported wood pulp.

## **4. Manufacture of Kraft Grades from Indigenous Raw Materials**

### **4.1 Rice Straw**

On account of the fibre characteristics of rice straw, it is not possible to use more than 20% or 30% for grades such as sack kraft, kraft liner and strong wrappings. This basic requirements for these grades would be long fibred pulp from coniferous species. However, a high percentage of straw pulp could be used in the manufacture of corrugating medium.

### **4.2 Bagasse**

As in the case of rice straw, bagasse will require long fibre pulp for the manufacture of sack kraft and other wrapping grades. At least about 50% to 60% long fibre pulp will have to be used to manufacture kraft grades. Like straw, a very high percentage of bagasse pulp could be used for the manufacture of corrugating medium.

### **4.3 Hardwood**

It is comparatively easier to produce unbleached grades from mixed tropical hardwoods than bleached grades. In view of its short fibre length, it is necessary to use as much as 60% long fibred wood pulp to manufacture strong kraft paper for conversion into multi-wall bags. Like the agricultural residues a

higher percentage of hardwood pulp could be used for the manufacture of corrugating medium.

### **4.4 Bamboo**

Compared to tropical hardwoods and agricultural residues, it is possible to use a higher percentage of bamboo pulp in view of its fibre length for the manufacture of kraft grades. Even in this case, particularly in the manufacture of sack kraft, to obtain the required strength characteristics on this grade at least 30% of coniferous wood pulp should be used.

## **5. Manufacture of Newsprint from Indigenous Raw Materials**

Newsprint manufacture is mainly based on coniferous wood, particularly on Spruce. The lack of conventional long fibred material has not prevented the development of the newsprint industry in areas that are in short supply of coniferous species. Newsprint is presently manufactured in India, Pakistan, Australia and Japan using non-traditional raw materials i.e. hardwood blended with long fibred chemical pulp.

Although hardwoods have been found satisfactory, it is necessary to blend it with long fibred pulp to obtain newsprint combining the characteristics of good runnability on the paper machine as well as good printability on high speed printing machines.

An evaluation of the raw materials for the manufacture of newsprint in the region under consideration can be summarised as follows:

## **Rice Straw**

The production of a cheap grade of paper like newsprint out of rice straw would not be possible due to the fibre characteristics of the pulp, the cost of pulping and the resultant low yield.

## **5.2 Bagasse**

The work that is being carried out in Mexico and Peru indicates that manufacturing processes are being developed for the use of bagasse as a raw material for newsprint manufacture. The feasibility of operating a newsprint mill, however would depend on :—

- (a) Construction of large sized sugar mills within a definite area.
- (b) A cheap replacement fuel for the sugar factories.

Some of the investigations that have been carried out indicate that the manufacture of newsprint from bagasse is not promising due to high fuel cost.

## **5.3 Bamboo**

Bamboo is not available in sufficient quantity to be considered as a raw material for the paper industry in Ceylon. Therefore, the question of making use of this material for newsprint manufacture does not arise. In the case of India, newsprint manufacture is based on bamboo as a raw material for chemical pulp only; no attempt has been made to use this material to produce either the groundwood pulp or its equivalent as in the case of conventional newsprint. Besides technological reasons limiting the use of bamboo for newsprint manufacture,

the other limiting factors would be the high cost of extraction and transport compared with suitable woody materials for newsprint manufacture.

## **5.4 Hardwoods**

The newsprint industry has to largely depend on woody materials. Tropical hardwoods are presently being used both in Pakistan (Gewa wood) and in India (Salai wood). It may be possible to start newsprint mills in other parts of India and Ceylon provided hardwoods of homogeneous composition can be collected in large quantities at a reasonable cost. Unfortunately, the region is poor in respect of the availability of large natural stands of tropical hardwoods of uniform fibre characteristics. Even where natural forests are available and hardwoods can be used, long fibre wood pulp to the extent of 25% to 35% has to be used as chemical pulp for the manufacture of newsprint.

### **5.4.1 What about Rubberwood—a Homogeneous Hardwood?**

Rubberwood has been suggested frequently as a potential raw material for the paper industry in Malaysia, Indonesia, India and Ceylon. Rubberwood trees have a useful life of 30 to 35 years at the end of which they are replaced by new trees. Since rubberwood is homogeneous in comparison with other hardwoods in the region, work has been done to explore the possibilities of using this wood for the paper industry and in particular for newsprint manufacture. In considering this raw material for the proposed newsprint project in Malaysia, Jaakko Poyry & Co. in "An Appraisal of the News-

print Development Opportunities in Asia" submitted to the F.A.O., have indicated as follows :—

"Rubberwood.....has not yet proved a suitable fibre for newsprint, neither as main furnish (groundwood or semi-mechanical pulp fraction) nor as pulp portion in admixture (Chemical pulp fraction)"

It should be also noted that rubberwood has other competitive uses such as in the manufacture of chip board, furniture, carbon black and as a cheap fuel for domestic purposes. It is therefore doubtful that rubberwood would prove to be a cheap material for the manufacture of paper.

### **5.4.2 Should Eucalyptus Plantations be promoted?**

Eucalyptus is indigenous to Australia where the first attempt was made to use it for the production of paper on a commercial scale. Although there are about 500 species of eucalyptus, only selected species could be used for paper making.

In the case of India and Ceylon, eucalyptus will have to be made available to the paper industry through man-made plantations. Being a short fibred material, the question would be whether eucalyptus merits consideration in view of the availability of agricultural residues and tropical hardwoods in the region. In spite of its short fibre length and the problem of obtaining satisfactory mechanical or semi-mechanical pulp from the young eucalyptus trees for newsprint manufacture, there are certain advantages in using eucalyptus as compared with mixed tropical hardwoods.

It should be also realised, although the region requires long fibre materials through man-made forests, eucalyptus plantations could be considered as an interim measure. Eucalyptus compared with conifers has the advantage of a short growth rotation as well as the possibility of growing on uneconomical lands which will not interfere with agricultural production.

#### **6. Review of Raw Material Supply to Meet Paper Industry's Requirements for the Manufacture of Diversified Grades**

Mills in the region are currently operating satisfactorily using agricultural residues and hardwoods for the manufacture of writings and printings. The present operation is based on the supply of long fibre pulp in the form of bamboo pulp or imported wood pulp. For mills that are operating on imported wood pulp the problem is serious in view of foreign exchange difficulties, as mentioned before and there is an urgent need to have indigenous fibrous materials which could be used as long fibre pulp.

A high percentage of long fibre pulp has to be blended with agricultural residues and tropical hardwoods for the manufacture of kraft grades such as sack kraft, kraft liner, etc. In the manufacture of newsprint, agricultural residues will not be suitable for reasons which have already been given. For technological reasons newsprint manufacture should be based mainly on woody materials. For newsprint manufacture, tropical hardwoods have their own limitations in view of heterogeneity as well as cost of production.

Based on the limitations of the indigenous raw materials currently available in the region, it should be stressed that for further expansion of the paper industry in India and Ceylon as well as to conserve foreign exchange, which has become increasingly difficult, it would be necessary to develop man-made forests that could supply this long fibre material for the paper industry.

#### **7. Development of Man-Made Forests for Long Fibre Material Supply**

The possible long fibre materials that could be developed in the region are as follows :—

- (1) Bamboo
- (2) Conifers

Bamboo, as already discussed, is being used, particularly India, as a long fibre material for the manufacture of various grades of paper, both with tropical hardwoods as well as agricultural residues. The development of bamboo for the paper industry has problems associated with gregarious flowering, fire damage and cost of extraction. The best alternative under these circumstances would be to develop man-made forests in the form of coniferous plantations.

The possibility of quick growing pines as a raw material for the paper industry has been proved in many countries such as Chile, South Africa, Southern Parts of U.S.A., Australia and New Zealand. Based on this pattern of development, it would be necessary for this region to embark on a programme of quick growing species that could supply the deficient long fibre materials. It

would be of interest to countries in this region to consider the work carried out in Malaysia and Indonesia on the growing of tropical coniferous species.

#### **8. The Need for Making Available Long Fibre Substitutes on a Crash Programme to Save Foreign Exchange**

Even though tropical conifers could be grown in the region, it should be noted that the cycle for these species is 15 years. A crash programme is therefore necessary where raw materials having a short growth cycle are supplied to the paper industry to partly or fully replace the long fibre substitutes that could be considered under a crash programme for the region are:—

- (a) Kenaf (*Hibiscus cannabinus*)
- (b) *Sesbania grandiflora*

##### **8.1 Kenaf as a Long Fibre Substitute**

Kenaf could be considered as an ideal material under the crash programme in view of its short cycle of 4 months. Kenaf is a tall, fast growing annual plant that could average a height of about 10' to 15' with a diameter of 1" to 1½". According to the yield results reported by the United States Department of Agriculture about 4 to 20 tons (A.D.) weight of kenaf stalk per acre could be obtained under varied growing conditions. Work done by Messrs. H.J. Nieschlag, G.H. Nelson and I.A. Wolff indicates that Kenaf merits consideration as a source of pulp fibre. The strength characteristics of kenaf pulp, according to their research, were found

to be superior to commercial hardwood pulp and were generally comparable with soft wood pulp, except for resistance of tear. For mills that are based on agricultural residues and in particular straw, it would appear that kenaf pulp blended with straw pulp, in view of the strength properties and other characteristics it possesses, should partly or completely replace imported wood pulp in grades such as writings and printings. However, it would be necessary for further work to be done on kenaf to determine optimum conditions for the use of kenaf pulp blended with straw pulp on a commercial scale. It should be also recognized, that so far there is not a single mill operating based on kenaf and as such the development of this raw material requires considerable work. In the manufacture of strong grades such as kraft and strong wrappings, it may be possible to use kenaf pulp, agricultural residues and long fibre pulp in certain proportions to meet the end requirements of such grades. As in the case of writings and printings, by introducing kenaf pulp, it should be possible to reduce substantially, the long fibre component of this grade that is being imported to the country spending valuable foreign exchange.

M/s. Jaakko Poyry and Co. in their report submitted to the F.A.O. regarding the newsprint project for Thailand have stated that for the manufacture of newsprint, the wastes from kenaf have been considered as a potential raw material and "the woody short fibre shives constitutes about 70% of the weight of kenaf stalks and may be converted into chemi-mechanical

pulp" According to them"..... Laboratory experiments on newsprint from kenaf have been carried out, but the technical and economical feasibility has yet to be established in mill scale trials. Economical calculation have shown that a chemical pulp mill cannot afford to pay an attractive price for kenaf to the farmers. Because of the many unsolved practical questions which will have to be clarified by additional research, case study based on kenaf was not yet considered possible."

## 8.2 *Sesbania Grandiflora*

*Sesbania Grandiflora* can be considered under the crash programme as a long fibre substitute for manufacturing certain grades. It is believed this plant could be raised in India and Ceylon without much difficulty. The yield per hectare is rated to be 125 tons A.D. with a short rotation of 3 years. According to the report published by Messrs. A.S. Bhat, M.M. Menon, J.N. Soundararajan and R.L. Bhargava in the 'Indian Forester', the pulp produced from this raw material is extremely good for semi-chemical pulping. It is reported cheap printing, writing, magazine and newsprint paper could be produced with 42% to 60% of *Sesbania Grandiflora* pulp mixed with chemical pulp from bamboo. Based on the details given in this report there are possibilities of using this pulp for blending with agricultural residues so as to partly or fully replace the long fibre component in the form of bamboo pulp or imported wood pulp. The replacement of long fibre pulp with *Sesbania Grandiflora* is of great interest to mills that are

presently using imported wood pulp. Although laboratory investigations indicate *Sesbania Grandiflora* as a promising pulping material, further development work is needed through pilot scale plantations and pilot scale commercial runs to establish the possibility of using this fibrous material for the paper industry.

## 9. General Conclusions

- 9.1 India is short of long fibred woody materials. Ceylon currently has no long fibre raw material and is entirely dependent upon imported wood pulp.
- 9.2 There is an urgent need to develop man-made forests that could produce these fibrous materials for the development of the paper industry in this region.
- 9.3 Man-made forests should be in the form of tropical conifers as far as possible, and wherever there are difficulties connected with the growing of coniferous species, bamboo is to be considered for planting to produce the long fibre pulp needed for the region.
- 9.4 Due to problems that may arise on account of availability of land suitable for the growing of tropical conifers, it may be necessary to consider the growing of eucalyptus, primarily to supply the woody material required for newsprint production.
- 9.5 Since woody materials i.e. tropical conifers as well as eucalyptus require a cycle of 15 years there is an immediate

need to implement a crash programme to prevent imports of pulp and paper and thereby save foreign exchange.

9.6 The long fibre substitutes that could be developed under the crash programme for these regions are kenaf and *Sesbania Grandiflora* in view of their short rotation of 4 months and 3 years respectively.

9.7 Further studies are needed on kenaf and *Sesbania Grandi-*

flora through pilot scale plantations and pilot scale mill runs to develop this material further for the manufacture of writings and printings, Kraft grades and newsprint.

#### References

1. Jaakko Poyry & Co. *An Appraisal of the Newsprint Development Opportunities in Asia*. Report to the F.A.O. and Agriculture Organization of the United Nations (FAO) Report No. 1.388. June.

2. H.J. Nieschlag, G.H. Nelson and I.A. Wolff. *A Search for New Fibre Crops*. Parts i—iv. TAPPI—July 1961. Vol. 44 No. 7.

3. Seth V.K. *The Promise and Problems of Indian Hardwoods as a Source of raw material for the pulp and Paper Industry*. IPPTA—April, May and June 1971. Vol. VIII. No. 2.

4. Bhat A.S., M.M. Menon, J.N. Soundararajan and R.L. Bhargava. *Sesbania Grandiflora—A Potential Pulpwood Materials*. Indian Forester TIARCM 1271.