# Experience on Utilisation of Mixed Hardwood for Kraft Manufacture at Star Paper Mills, Ltd. Saharanpur.

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The experiences of the STAR PAPER MILLS. SHARANPUR in the production of Kraft Papers from such heterogenous Pulp Woods of inferior quality as slash wood are briefly detailed. Mechanical handling of such wood has been impossible and recourse to manual handling is a stupendous task involving huge labour and wastage.

A vivid account of the difficulties in chipping, digesting and other operations encountered in the use of such widely different woods is given. The author concludes with a note, that with the co-operation of the various Forest Departments, the Industry can scientifically exploit the vast areas of hard wood for the manufacture of Paper.

## Summary :

A modern and sophisticated plant was installed in 1962 at the Star Paper Mills Ltd., Saharanpur for the manufacture of kraft papers from twisted chir (Pinus excelsa). As the requisite supplies of chir pulpwoods, though stated earlier by the U.P. Forest Department to be available, could not be procured, the Mill has been compelled to use woods available in the open market in order to utilise to the maximum extent possible the installed capacity of the plant. A major portion of the woods purchased in the market is of a heterogenious mixture of hardwood species, consisting of logs and a fairly large proportion of slashwood (off-cuts, crooked bolts, lops and tops, stumps, roots etc. ) and decayed wood. The experience of the mill on the production of Kraft papers from such heterogenious pulpwoods of inferior quality is briefly detailed under the various heads of manufacturing operations, pointed attention being drawn to the difficulties encountered in the manual handling of wood supplies, a fair proportion of which consists of slashwood of odd sizes, shapes and dimensions.

On the ground that the future growth and development of the Pulp and Paper Industry is inevitably dependent on the use of pulpwoods, largely of the hardwood species, an earnest plea is made for the necessity and desirability of the various State Governments formulating a policy regarding supplies, from the forests, of the requisite quantities of pulpwoods of standard specifications, to the Pulp and Paper Industry. An appeal is also made to the various State Forest Departments to implement the policy by extending their wholehearted support and co-operation to meet to the maximum extent possible the growing demands for pulpwoods and thus play a worthy role in the development of an industry of vital importance to the national economy of the country.

Star Paper Mills was established as a one machine unit in 1938 for the manufacture of 3500----4000 tonnes per annum of writing and printing papers from **sabai** grass (Eulaliopsis binata), procured from the neighbouring Siwalik hills.

In 1955, the paper machine was renovated and the pulp plant expanded to step up the annual production of papers to about 6000 tonnes per annum. Before long, even this increased production was found uneconomic in the face of the growing internal competition. The management were, therefore, anxious to bring up the production to an economic level. Availability of requisite raw materials was, however, the problem. Luckily, about this time, the U.P. Forest Department gave out that large supplies (about 38,000 to 40,000 tonnes p.a.) of twisted **chir** were available from Kumaon circle. This material had no commercial use at the time and was declared by the Forest Research Institute, Dehra Dun, as an

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excellent paper-making material, having fairly long fibres. The Management of the Mills, encouraged by these pronouncements, undertook a project to utilize the material for the manufacture of about 16,000 tonnes per annum of kraft papers, which were till then almost entirely imported from abroad, and thus bring up the production of the Mill to about 22,000 tons per annum.

A modern pulping plant suitable for the pulping of chir pulpwood and two modern paper machines for the manufacture of M.G. and M.F. Kraft papers were procured from abroad at a capital cost of about Rs. 3.0 crores and production of papers was started in 1962. At the very outset, however, the Mill came up against serious difficulties with regard to the supplies of chir pulpwood. When approached for the lease of chir forest areas, the U.P. Forest Department expressed their inability to supply the requisite quantity of chir pulpwood for the production of 16.000 tonnes per annum of papers. They allotted only about 22,000 tonnes of pulpwood (about 30-40% moisture), nearly half of which consisted slashwood (off-cuts, crooked and twisted bolts, lops and tops, branches etc). Apart from the utter inadequacy of the supply, the large percentage of slashwood, which is nowhere classed as pulpwood for pulp and paper manufacture, was found to be very difficult and uneconomic to use, particularly as the plant put up at the Mills was not designed for processing such wood.

As a result of further representations to the U.P. Forest Department, the Mill was allotted a further supply of about 12,000 tonnes of **chir** thinnings (also containing about 30-40% moisture.) For various reasons the total allotment of about 34,000 tonnes of **chir** wood was not available to the Mills. The average quantity actually received in the Mills was only about 16,500 tonnes per annum.

As the required supplies of **chir** pulpwood were not available from the U.P. Forest Department, the Mill, in order to utilise the production capacity of the expensive plant to the maximum extent possible was **compelled to purchase in** the open market, whatever wood was available and thus tried to make up the shortfall of **chir** pulpwood supplies.

The market supplies consisted partly of pinewood from the Punjab, but largely of Kokat

(mixed hardwoods), extracted by timber merchants and contractors from the U.P. Forests as fuelwood. Use of fir and spruce rejects (hakri) was found to be too expensive to use. The Kokat wood, supplied by contractors, again consisted of a large proportion, almost 40% of slashwood (off-cuts, crooked and twisted bolts, stumps, roots etc.). The contractors expressed their inability to make better supplies in view of the growing demands for fuel wood and of higher prices it fetched them. The Mills, in order to keep up production, were there. fore, very reluctantly compelled to accept supplies of slashwood, even though these were very unsuitable and uneconomic to use. The average annual market purchases of Kokat wood during the last 4 years has been about 35,000-36,000 tonnes, containing on the average 35% moisture.

The experience of the Mill of using mixed hardwoods, and slashwood as described above. for Kraft paper manufacture, is briefly detailed below, under the various heads of manufacturing operations.

## Handling and transportation :

The supply of hardwoods (including slash-wood) consists of :

- (a) logs, bolts, and branches varying in length from 1' to 6' and in diameters from  $\frac{3}{4}$  " to 30". Fairly large proportion of these contain abnormal number of knots. The weight of individual pieces in a lot varies from 5 Kg. to 500 Kg.
- (b) crooked, twisted and decayed bolts and small pieces.
- (c) stumps, roots and bolts having hollow space in centre full of mud, stones etc and
- (d) very old logs and bolts, largely rotten inside.

The handling of the above type of wood for loading, unloading and transportation in trucks or by rail-road has been a stupendous problem and the difficulties faced may well be imagined, particularly in view of the scarce availability of labour. Mechanical handling of such a supply, if not impossible, is extremely difficult. World's top mechanical handling experts have not been able to

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suggest a suitable solution of the problem. The Mill has been forced to have re-course to manual handling, which is obviously considerably wasteful in time and labour. It is found that the total manhours required to handle 100 tonnes of the supply for (a) storage in mill yard; (b) sowing and dressing to make it suitable for chipping, and (c) conveying to the chipper house is, on the average, 100 as compared to 1 in Western countries, where the right type of pulpwood is available to the mills.

In these days of rising labour wages, very heavy expenditure is incurred, therefore, in manual handling of thousands of pieces of wood per day, for storage in mill yard, and for conveying them to the saw mill for dressing and then to the chipper house. Apart from this, time consumed in manual operation and dressing of the wood retards the feeding rate to the chipper house, and this affects production very adversely. Moreover, deformed and odd shaped pieces of wood, more often than not, cause frequent stoppages of the conveying equipment and the chipper, resulting in further loss of chipping capacity and production.

## **Chipping**:

Hardwoods are characteristically comparatively more difficult to chip than soft woods (conifers). If pieces of wood to be fed into the chipper contain abnormal number of knots, or form part of stumps, roots etc. or are crooked and twisted and of odd sizes and shapes, not only the knives and knife-holders often get broken and damaged but the chips produced are not uniform and regular in size and shape. The percentage of oversize and undersize chips and needle chips etc. is also very high. A set of knives, which would chip about 400/ 500 tonnes of normal softwood is found to chip only 80-100 tonnes of the above type of mixed hardwoods. This necessitates mere frequent change of knives, resulting in increase 'down time' of chippers

## **Digestion** :

Until recently, due to lack of facilities in the mill for cooking hardwoods and pinewood separately, both types of wood have been cooked mixed together. It is found that this method is very unscientific and uneconomical and therefore very unsatisfactory, even though acceptable quantities of papers from the pulps have been produced at the

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Mills. The method is not only wasteful in chemicals and raw materials, but results in lower pulp yields and comparatively poor quality of pulps. This is mainly due to the fact that the charge for digestion consists of chips which are not uniform and regular in shape and size, and vary widely in physical and chemical characteristics. Pinewood chips have different density to hardwood chips and the motley mixture of hardwoods used have densities varying within a wide range. Further, the chemical compositions of pinewood and the motley mixture of hardwoods differ widely. The cooking of such a heterogenious mixture of chips, under fixed conditions of digestion variables viz concentration of chemicals, time and temperature, is bound to result in the overcooking of a part of the charge and undercooking of another part. The resulting pulp, therefore, is far from uniform, varying widely in its Permanganate number and frequently contains a fairly large percentage of screenings. It is found that the percentage yield of pulp also is below normal, that is lower than what would have been obtained if pinewood and hardwood were cooked separately and if the hardwoods used did not very widely in physical and chemical characteristics between themselves.

In view of the very serious disadvantages of digesting soft and hardwood together arrangements have recently been made for cooking them separately. It is too early to make any comment on the change, except that cooking of mixed hardwoods sometimes gives trouble in the clean blowing of digesters. The drawbacks of cooking the type of hardwoods obtained at the Mill will, however, continue so long as proper and acceptable pulpwoods of the mixed hardwood species are not available.

# Washing and Screening pulp:

Washing of pulp from hardwoods has **presented** certain difficulties particularly as the equipment, consisting of a combination of vacuum and pressure washers, was designed for washing of pulps from long-fibred materials. The short fibres and cells from hardwood pulps choke the screen plates of the screw press washer. Moreover, the short fibres and cells pass into black liquor in very appreciable quantities. The pulp from mixed hardwoods, though rather slow draining behaves satisfactorily on vacuum washers. On the whole, however, the efficiency of the washing plant is found to be lowered when mixtures of pinewood and hardwood pulps are washed on it. It is found that only a small percentage of hardwood pulps can be mixed with long-fibred pulps wihout appreciably lowering the efficiency of the plant. However, the circulation of mixed pulp is satisfactory in chests, it has little tendency to float and is easy to pump.

Screening of hardwood pulps does not present any serious difficulty. The conventional screens are found satisfactory for these pulps. Further, these pulps do not give any trouble in centri-cleaners and other equipments used for cleaning pulp.

#### Bleaching :

No comments can we made on the bleaching of pulps from mixed hardwoods as bleached wood pulp has not been required in the Mill.

#### **Stock Preparation :**

Hydrafiners and Jordans are found to be quite suitable equipments for refining pulps from mixed hardwoods at consistency of say 6%. No difficulty has been experienced in handling pulp of the above consistency in storage chests, pumps and pipelines. Until recently mixed pulps from pinewood and hardwoods have been beaten and refined together. It is found that the mixture of long fibres from pinewood and short fibres from hardwood does not get the required treatment for the bill full development of fibre characteristics, necessary for the production of particular grades of papers. Beating of longfibred pine pulp requires cutting action, whereas meating of short and bulky pulp from hardwoods needs only fibrilation and brushing and no cutting. Beating and refining, of mixtures of long-fibred and short-fibred pulps, therefore, is far from satisfactory. Consequently, equipment for separate refining and beating of the two types of pulps has recently been installed at the Mill. Horsepower ton per day required for beating hardwood pulps is found to approximate 23 as against 29 for pine wood pulps.

### Paper making:

Blends of pinewood and hardwood unbleached pulps, if properly beaten and refined do not present appreciable difficulties in runs on Fourdriner paper beating of short and bulky pulp from hardwoods pulp with pinewood pulp carries enough water on the wire, is comparatively free draining, permitting higher head-box consistencies, without any detri-

mental effect on sheet formation and it drains well on suction boxes and suction couch. The resulting sheet, though comparatively dense and closely formed, has comparatively low tear and moderate tensile strength. The bursting strength is, however, quite satisfactory. Admixtures of higher percentages of hardwood pulps than 10-15% lower sharply tearing strength and diminish tensile strength but bursting strength is not affected appreciably. Glaze of the sheet on M.G. Machine is not materially affected upto an admixture of 50% hardwood pulp with pinewood pulp. The only difficulty experienced in running admixtures of long-fibred and short-fibred pulps is on the presses. There are frequent "press" breaks. The difficulty is however, largely minimised by proper care and judicious selection of press roll covering material.

#### Soda Recovery :

The Evaporating plant at the Mills has been designed for evaporating black liquors to 60% solids. Difficulties have been experienced in evaporating black liquor from hardwood digestions to this consistency, due mainly to formation of gelatinous scales in the last two effects of the Evaporators, as a result of fines, cells and resinous substances in hardwood pulps passing into the black liquor. This trouble is minimised if the mixed hardwoods are allowed to be stored for few months before use. Combustion in the Furnace is also imperfect, partly due to smaller percentages of organic residues in the black liquor from hardwood digestions, which, consequently has lower calorific value than black liquor from pinewood digestions. With more than 50–55% of hardwood black liquor in the liquor going to the Recovery House operation of the Evaporators and Furnace becomes extremely difficult, almost impossible.

In conclusion, it may be pointed out that the experience at Star Paper Mills on the utilisation ot mixed hardwoods for the manufacture of kraft papers has been limited to a supply of the raw material, a good proportion of which consists of stumps, roots, thin tops, branches, decayed and deformed wood etc. which, on economical and technical grounds, cannot possibly be classed as acceptable pulpwood. Further, the supply consists of a mixture of a number of species of hardwoods, some of which, on account of their physical and chemical properties, may not be suitable pulpwoods. The circumstances in which the Mill has been compelled to use the mixture of acceptable and

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unacceptable pulpwoods have been stated earlier in the paper.

In the present conditions of acute scarfit of suitable raw materials, increasing use of hardwoods is an inevitable necessity for the growth and development of the Paper Industry in the country. The State Forest Departments have obviously to play a very important role in this development. No large scale industry, much less a specialised and sophisticated industry like the Paper Industry, can be successfully run if it has to depend for the supply of its requirements of raw-materials on the vagaries and fluctuations of the market. Its total requirements of the right quality of raw materials must be fully assured. In the case of the Paper Industry this essential condition can be satisfactorily met only with the help and cooperation of the State Forest Departments, which would certainly be forthcoming if the supplies of the requisite quantities and qualities of pulpwoods are made available to the Pulp and Paper Industry in pursuance of a policy laid down and declared by the various State Governments. For the implementation of the policy, the State Forest Departments have to earmark, in forest coupes to be auctioned annually, certain species of hardwoods as pulpwood. These species may be such as are, from time to time, found suitable for pulp and paper manufacture by the Forest Research Institute, Dehra Dun. In case the outturn of these species from the various coupes is not adequate to meet Paper Mills demands. Further, certain necessary measures, such as construction of roads etc. have to be taken by the State Forest Departments to provide for the economic extrac-

tion of the above species and for their availability as acceptable pulpwood to the Paper Mills, at a cost, which the Industry can bear. This is necessary in as much as paper is indispensable for educational, cultural and commercial needs and must, therefore, be available to the common man as cheaply as possible.

It needs hardly be stated that the future growth and development of the Paper Industry depend very largely on the use of pulpwoods (both softwoods and hardwoods). Should the Industry's requirements of these be not, fully met, the development is likely to have a serious set-back or may even come to a halt. In almost every State in the country, several thousands of square kilometers of forest areas Exist under hardwood species. Scientific exploitation of these areas by modern methods should enable the Forest Departments easily to meet the growing demands of pulpwoods, at least until such time as the recently raised plantations of Eucalyptus and other fast growing species in some States are in a position to meet them. It is hoped that these plantations have been or will be undertaken on scales sufficiently large to meet the future requirements of pulpwood of the Pulp and Paper Industry.

To end, the Pulp and Paper Industry earnestly appeals to the State Forest Departments to take a national view of the matter and to make a worthy contribution towards its growth and development, as it is an industry of great and vital importance to the national economy of the country.

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