Use of Hardwood Pulps for Manufacture of Printing Papers

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[After dealing with sheet forming characteristics of different types of hard wood pulps, their refining and blending processes for their incorporation into long fibred pulps to run the stock at high speed machine have been discussed. The problems of sheet formation and flocculation of fibres which are the matters of common occurrence when there is mixed furnish of long fibred and of short fibred pulps on the run, are also discussed.]

Introduction:

With the literacy drives and rapid industrialization of our country the demand for printing papers specially of the newsprint grade is rising at a rapid pace. There are about 9300 publications of Newspapers and Magazines in our country which are printed mostly on newsprint. The consumption of newsprint is little above 110000 tons and with the steady increase in the number of these publications it is estimated that this figure would reach 200000 tons a year by the end of Third Plan. A considerable quantity of newsprint grade papers are in demand in our country but in context of world demand it is very small. Per capita consumption of newsprint in India is 0.25 Kg. as against the world figure 5.6 Kg.

1. Sheet-forming Characteristics of Hardwood Pulps

Generally hardwoods are differentiated by fibre lengths which varies in case of hardwoods from 1 to 1.5 mm. and in softwoods from 2.5 mm to 7 mm. The characteristic of the fibre i.e. fibre width, lumen width, cell wall thickness all play an important role in formation of pulp sheet. Thin walled fibres of large diameter collapse to flattened ribbons in the process of sheet formation to form a compact pulp sheet with highly effective fibre to fibre contact areas. Such pulps are characterised by high burst and tensile strength. Conversely thick-walled fibres (Hardwood-fibres) of small diameter resist collapse and retain their tubular shape to form bulky-sheet. So fibres with thick-wall furnish soft and opaque papers whereas those with thin walls yield solid and transparent papers.

Numerous investigations have shown that fibre-length alone is inadequate to portray the significant characteristics of fibre in relation to the strength of paper. Fibre length has practically no influence on such properties as tensile strengths and burst provided the fibre length is above 8 mm. Due to short fibre length and higher cell wall thickness of hardwoods, the sheet forming properties of hardwood pulps are excellent. The short-fibre hardwood pulps are therefore preferred in blends when producing book papers and fine printings.

2. Varieties of Hardwood Pulps and Sheet Characteristics

(*i*) *Ground-Wood Pulps*

The Ground wood pulp because of its low cost is widely used in papers where high strength, high brightness and permanence are not important factors. Its use imparts opacity, bulk and good printing qualities to the sheet and its drainage characteristics

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can be controlled to allow high paper machine speed in manufacture of newsprint grade paper.

(ii) Cold Soda Semichemical-pulp—CSSC

It is strong-pulp at cheap price. It can replace a high percentage of both chemical and mechanical pulps in manufacture of printing papers because it contains a lower fraction of coarse and fine fibres than coniferous ground wood. Its average fibre length is more and hence it has higher strength and original freeness. The last property makes it possible to increase machine speed when it is present as a fair percentage in furnish. This pulp has high density (low bulk) and somewhat low opacity—which are quite serious deficiencies in its utilization in printing papers. CSSC pulp made from hardwood of diverse densities has been found to yield good quality pulp for incorporation in newsprint furnish. It being a bit darker in shade than customary ground wood, hence it is semi-bleached.

(iii) Neutral Sulphite Pulp

This pulp can be hydrated very esasily to produce dense stock with good formation characteristics. For a hardwood fibre the strength features are superior to normal sulfite and compare quite well with Kraft. They tend to produce hard dense sheets. Many species of hardwoods however have high lignin content or high extractives are not well suited to this process. Light coloured woods are necessary for light coloured unbleached pulps.

(iv) Chemiground Pulp

In general Chemiground hardwood pulp has faster drainage characteristics than the regular spruce and fir ground wood. Wide variations in pulp properties are possible through cooking and grinding control. The Chemiground wood pulps with physical properties more nearly equal to normal spruce and fir ground wood are useful in the furnishes of high speed newsprint manufacture.

(v) Chemical Pulps

Bleached pulps from hardwoods are of very high quality, i.e. high brightness and high strength properties. These pulps may be used for fine printing papers for books and magazines. The bleached pulp of 80% brightness gives following strength properties of standard hand-sheets made at 300°C.F.

1. Breaking Length. 8000 to 9000 Mds.
2. Burst Factor. 50 to 60
3. Tear Factor. 100 to 120
4. Double Folds. 200 to 500

The following table gives comparative idea regarding the quality of pulps manufactured from different processes for a particular species of hardwood. The standard hand sheets for pulp evaluation were made at 300°C.F.

Process	*Kraft*	*CSSC*	*Cold Soda*	*Ground Wood*
1. Yield%	45	65-85	85-90	90
2. Brightness	85	75	75	70
3. Opacity	75	80	88	94
4. Tear	90	75	65	10
5. Burst	60	25	20	5
6. Power requirement (H.P/ Ton Pulp)	15-25	30-60	50-60	70

3. Working of Hardwood Pulps for Stock-preparation

Chemical, semi-chemical or ground wood pulps from hardwoods may be used in different proportions alongwith long fibred chemical pulps for manufacture of fine quality printing papers as well as newsprint grade papers on highspeed machines running in the range of 800 f.p.m. to 1200 f.p.m.

The essential elements of quality in these printing papers are:

1. Even formation as shown by the clearness of "look through".
2. Uniformity of basis weight and thickness.
3. Smoothness of surface.
4. Adequate tensile strength particularly in the machine direction.

5. Cleanliness and freedom from shives.
6. Uniformity of colour.
7. Adequate opacity.
8. Satisfactory printing—ink absorbency.
9. Freedom from mechanical defects, as slime spots, calender cuts etc.

In some of the elements of quality listed above, the characteri tics may vary with the species of hardwood used and their method use in making ground, chemical or semi-chemical pulps. In others they are effected by refining, blending and screening procedures adopted in the preparation of pulps.

In other cases the quality of paper is affected by pressing, drying and calendering but the prime importance of wet end from mixing equipment to the couch is unquestioned. To a major extent the quality of newsprint grade-papers is composite of all the factors listed. Paper-making skill in adjustments of the manufacturing procedure must compensate for inherent differences in stock quality seasonal variations and other factors.

4. Refining of Short-fibred Hardwood Pulps

When the short fibred hardwood pulps are blended in suitable proportion with long fibred coniferous wood pulps these improve sheet-formation surface characteristics and printability of the printing papers. The refining of such pulps should be such that the fibres are fibrillated but no further shortened otherwise the amount of debris in the stock would increase resulting in lower drainage rate of pulp stock and thereby ultimately, lowering of the machine speed.

In order to achieve this firstly the fibres should be cooked under milder conditions or semi-chemical pulps are prepared so that the hemicelluloses which act a cementing agent to provide high strength properties in paper are retained and as well as the fibres should have sufficient original strength and freeness to withstand the impact of beating equipment. The thick cell wall and the fibrillation of hard wood pulps during the beating operation results in a cemented surface.

The refining of short fibred hardwood pulps should be done in disk type refiner in which mechanical fibre treatment takes place without any cutting or shortening effects. The refiner operates at a fixed clearance in order of the magnitude of average fibre length, between their working members rotating at high relative speeds. It can be fed with high fibre consistencies above 20%. In the gap between rotary and stationary member high velocity gradients effect intensive hydrodynamic shearing forces on the pulp of high consistency. A cutting or shortening of the fibres cannot occur due to relatively wide fixed clearance. The fibre 'surfaces' themselves will exert 'intensive' internal frictional forces on each other due to their high consistency and subsequent intimate contact. High 'tear properties' are obtained with simultaneous development of tensile and 'bursting strength' in the manufactured sheet from the prepared stock.

5. Stock Preparation for Newsprint Grade Papers

The papers of newsprint grade constitute major portion of ground wood or mechanical pulp 60 to 90% and the rest chemical pulp, sulphate or sulphite. The quality in ground wood and sulphate or the mixed stock is dependent on the characteristics of wood species used, on the grinding or cooking procedures followed, the screening and in the case of ground wood refining of the screen rejections.

Uniformity of quality of the resultant paper is also directly dependent on the controlled proportion of these components and the thorough blending of the mixed stock delivered to the paper machine. With the increase in the width as well as speed of the newsprint machines and consequent enlarged capacity per machine, came the development of Magazine Grinders and artificial pulp stones. With artificial pulp stones of aloxite or carborundum besides less frequent need of sharpening and possi-

bility of operating safely at much higher speed pulp of much more uniform quality is produced than with natural sandstone. For uniform quality of newsprint it is particularly necessary that the screening of pulps shives and coarse particles be removed. It is also the accepted practice to carry a supply of thickened ground wood and sulphate sufficient for several hours demand and that the pulp in slush form to be kept in constant circulation to prevent segregation of pulp from the suspension and change in consistency at any time.

6. Stock Preparation for Fine-printing Papers

In order to manufacture printing papers of fine quality and of uniform quality, it is needless to emphasize that the maintenance of uniformity is of vital importance in every stage of stock preparation like selection of wood species, the grinding of pulp, the digestion of sulphate pulp, the screening, thickening and finally blending of pulp in measured proportions after careful regulation in consistency with this uniformity of stock as it passes to the paper machine uniformity in physical properties and ultimate quality of the paper becomes possible with minimum of supervision.

The most desirable method for handling mixed furnishes of long fibred pulps and short fibred hardwood pulps in stock preparation for manufacturing fine printing papers on high speed machine running at about 900 ft./mt., is to beat each pulp separately and blend fully beaten pulp in a chest. In a continous system separate refining of mixed furnishes can be achieved by passing one pulp through the full refining system and putting the other pulp through a smaller portion of the refining system and mixing the two flows in a metering box. On the above basis black-claws on international have designed a stock preparation system to handle mixed furnishes of hard and soft wood. The flow diagram of the process is given in fig I.

7. Effect of Fibre Dimensions of Blended Pulps on Sheet Formation

A practical study was made to see the effect of fibre dimensions of bl nded pulps on the sheet formation of white printing 64 gms basis weight manufactured on fourdrienier machine at 900 ft./mt. The blended pulps were 60% coniferous wood pulp (Pinus Longifolia) and the rest 40% short fibred hard wood pulp. Fibres of each of the above constituent pulps were treated in series of Jordon-refines to different degrees of freeness before blending. Sometimes the degree of beating of each was very close and sometimes it was apart. Under both these conditions observations were made on formation of sheet manufactured thereby. The following are the observations.

WHITE PRINTING 64.0 GMS BASIS WEIGHT

Machine Speed—900 ft./mt. Furnish—60% Pinewood plus 40% Hardwood Pulp

	C.F. at 20°C		Strength Properties				Sheet Characteristics
	Pinewood pulp	Hardwood pulp	Bulk	Breaking Length meters	Burst factor	Fold	Tear factor	Formation
1.	406	298	1.03	2400	10.5	4.5	47.3	Very poor and very cloudy
2.	340	300	1.07	2835	11.0	4.5	47.4	Poor & cloudy
3.	315	280	1.20	3341	11.5	5.0	52.4	Good & uniform
4.	361	280	1.10	3149	8.5	3.0	42.3	Very poor & very cloudy

The above results show that as Canadian-freeness of pine wood pulp (long-fibred) approaches close to that of Hardwood pulp (short-fibred) about 300°C F the sheet formation gradually becomes better and uniform.

8. Flocculation of Fibres

One of the most frequent defects to be noted in manufacture of fine printing papers as well as newsprint grade papers on high speed machine at 1000 ft./mt. is the appearance of blotches.

The pulp slurry in which there is suspension of mixture of long and short vegetable fibres sometimes develop tendency to bunch together and form clots. As the stock leaves the paper-machine screens the fibre is completely dispersed and this doubtless is most important function. Consequently then where the flocculation occurs, it is plain that this takes place in the flow box while the stock is passing from screen discharge to the slice. More recently experience has shown that the lengthening of flow box was wrong principle to feed the high speed machine. Now the most modern Newsprint Machines operating at 1200 ft./minutes have come to head box with a single compartment with a baffle as in the old breast box.

It has been practically observed that the dispersion of fibres was best secured when there was a shortest distance and time between the screens discharge and slice thereby giving the stock the least time for flocculation.

Among the practical expedients for prevention of flocculation are:—

1. Reduce to minimum possible distance between screen discharge and slice.
2. Use of perforated plates, perforated rolls, tube racks and evener plates in the path of stock at the slice nozzle.
3. Avoiding cascading of stock from screen-discharge to entrance of flow box by which air is trapped in the suspension.

Conclusions:

In order to get excellent results by use of hard wood pulp alongwith long fibred pulp for manufacture of printing papers at high speed, special attention should be paid to the following:—

1. The particular species of hardwood for manufacture of printing papers should be chosen after thorough laboratory study on its pulp evaluation.
2. The refining of hardwood pulps should be done in a disc type refiner in which there is fibrillation of fibres but at the same time there is no further cutting of the fibres.
3. The percentage of hardwood pulp to be used in conjunction with long fibred pulp should be such that it does not give adverse effect on the speed of machine and quality of the manufactured paper.
4. Freeness of long fibred blended pulp should be very close to that of Hardwood pulp in order to get best results in sheet-formation.

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