Studies in the Production of Fluting Medium Paper from Mixed Hardwoods

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A study of the pulping of mixed hardwoads by the neutral sulphite semichemicals (N.S.S.C.) process has been made. The pulp yield was 70%. The pulp, refined in a laboratory Sprout Waldron disc refiner, washed and then beaten in a laboratory Valley beater to 40° S.R., was found suitable for the corrugated boxes. The strength and other properties of the product, though lower than that of the imported counterpart, were considered satisfactory for commercial purposes.

The limitations of the process have been discussed.

In India the use of hardwoods for pulping has started in early sixties due to insufficient quantity of bamboo being available to the Pulp and Paper industry.[1] However, Pulp woods, usually mixtures, of broad leaf species, are generally available to the industry and are used roughly to the extent of about 35 percent along with the bamboo pulp in the furnish for the production of various grades of Papers, like the writing, printing and the kraft. It may not be out of place to mention, that a few mills in India are also using Salai *(Boswellia serrata,* Roxb.*)* a hardwood for the production of mechanical pulp, for adding to waste paper pulp used in the furnish of back liner of Duplex board to provide the stiffness in the board. This is beside the use of this pulp for the production of newsprint. It appears that the possibilities of using hardwoods, for the production of fluting medium paper for corrugated board has escaped the attention of the industry although one of the present authors has earlier drawn attention regarding the use of 100 percent hardwoods mixture for the purpose.[2] Mixed hardwoods are generally pulped in India for the production of writing, printing and kraft papers much the same way, as bamboo, by the conventional Sulphate process either by a batch or a continuous cooking operation. Recently Andhra Pradesh Paper mill has started the pulping of mixed hardwoods by the Cold Soda process with some modifications to overcome some of their technical troubles.[3] In the present studies mixed hardwoods were cooked by the neutral Sulphite Semichemical (N.S.S.C.) process in a laboratoy digester.

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Experimental

Mixed hardwoods chips of various species (like *Boswellia serrata* Roxb, *Butea monosperma, Antho cephalus, Pterocarpusdal bergiodas, Anogienus sp, Pterocarpus, marsupium, Soymida febrifuga, Elaedendren sp, Logerstroemia sp, Saclopetalum Casaurina sp, Shorea sp,)* were taken for experiments. The chips classification is given in Table I.

Preparation for the cooking liquor: The NSSC cooking liquor was prepared by passing sulphur dioxide (SO_2) gas in a saturated sodium carbonate (Na_2CO_3) solution (300 g/l) till a pH of 4.0 was obtained. Then sodium cabonate solution was added until a pH 8.5 was obtained.

Sulphur dioxide gas is prepared on plant scale by burning sulphur. In

Table I

Chips Classifications

					Percent
A.	Through	1.5″	and on	1″	6.0
B.	,,	1″	,, ,,	0.75″	16.5
C.	,,	0.75″	,, ,,	0.50″	33.0
D.	,,	0.50″	,, ,,	0.38″	32.0
E.	,,	0.38″	,, ,,	0.25″	12.5

the laboratory sulphur dioxide gas was prepared by boiling copper turnings in sulphuric acid for the ease and purity of the gas produced and also for a continuous evolution and flow of the gas once the reaction started.

The strength of the cooking liquor was adjusted by adding water and/or sodium carbonate or both to have the following strength as shown in table II.

Table II
Showing the strength of cooking liquor

Sodium Sulphite	72 g/l	Calculated as Na_2O
Sodium Carbonate	47 g/l	

The conditions of pulping, as carried out in the laboratory rotary digester, are detailed in table III.

Table III
Showing cooking conditions of Mixed hardwoods by N.S.S.C. Process.

Wood: liquor ratio	1:4
Time taken to raise to the cooking temperature	90 minutes
Time at cooking temperature	90 minutes
Amount of Sodium Sulphite taken on B. D. Chips (reported as Na_2O)	3.75%
Amount of Sodium sulphite and Sodium carbonate on B. D Chips as Na_2O	5.20%
Cooking temperature	165°C
Unbleached pulp yield	72%
Final pH of black liquor	7.6

The cooked chips were refined in a Sprout Waldron disc refiner and then the pulp was well washed. The refined and washed pulp was beaten in a laboratory Valley beater to a freeness of 40° SR.

Hand sheets of 120 G. S. M. were made on a (German) hand sheet making machine. These hand sheets were conditioned in a desiccator at 65% R. H. A constant humidity liquor of 65% R. H. was prepared as suggested by Grant[4]. The conditioned samples were examined for various tests as indicated in Table IV. An imported sample (marked 'X') was also examined and the test results are included in the table for comparison.

The Crush Resistance of Fluting medium C. M. T. was tested on Hinde and Dauch Crush Tester. The hand sheet was cut 6"x 1/2" using a precision sample cutter. The cut sample was fed into Concora Medium Fluter. As the fluted sample came out from Concora Medium Fluter, it was immediately laid on the corrugated rack and the comb was placed over the fluted sample to hold it firmly into the flutes of the rack. A five inch strip of double coated scotch tape was placed on the exposed fluted tips. The sample was immediately removed carefully from the rack and was placed in the Hinde Dauch Crush Tester with the flutes of the sample up and the adhesive side downward i. e. the bottom platform of crush tester. The pressure was noted at the point of failure of the flutes.

Table IV
Showing physical properties of sheets.

	Hand sheets (from mixed hardwood NSSC pulp)	Imported Product* Sample "X" (for comparison)
G.S.M.	122	125
Caliper (mm.)	0.21	0.23
Bulk	1.72	1.84
C.M.T. (kg.)	28	34
Burst factor	18	31
Tear factor	37	55§
Breaking length, (metres)	2600	3500§

* nine point corrugating medium board paper. Nine point means the caliper of the paper is nine mils. The G.S.M. of the paper will be around 120 to 128.

§ Average of machine and cross directions.

A comparison of figures given in Table IV shows that fluting medium paper produced from N. S. S. C. pulp from the mixed hardwoods are lower than the imported nine point corrugating medium board paper (sample 'X') but even then the mixed hardwoods pulped by the N. S. S. C. process can be considered to be suitable for the production of fluting medium paper on a commercial scale. The requirement of this commodity in the country has considerably increased for the packaging of fergile items. Presently Kraft Paper is used in the country for

the production of corrugated boards. Kraft pulp has on an average yield of around 45% on the raw material, when produced by the conventional kraft cooking process, as compared to about 70% pulp yield from the same raw material (hardwoods) cooked by the N.S.S.C. process. Kraft paper has its own specific uses and should not be utilised for making flute for corrugated board on techno - economical grounds. In a country like India, which is suffering from a chronic shortage of raw materials for pulping, it appears strange that we should use Kraft paper (Yield 44%) for the production of corrugated boxes and not N.S.S.C. pulp (Yield 70%) for the purpose.

It may, however, be pointed out that a greater application of N. S. S. C. process for pulping of hardwoods (and for that purpose of other cellulosic materials) is handicapped due to the requirement of large quantity of Sulphur, which is an imported chemical and the lack of suitable mechanism for treatment and disposal of the effluents. Further, the power requirement for N.S.S.C. process (about 12 to 18 Hp./day/ton of air dry pulp for fiberizing[5]) is comparatively more. The use of sulphur as a cooking chemical reduces the longevity of the cooking vessel.

It may however be mentioned, in passing, that N. S. S. C. process if taken up in conjunction with the Kraft process will minimise the problems of treatment and disposal of the effluent of the N.S.S.C. process, as is done in some of the mills abroad.

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