Studies on the Fines of Bamboo Pulp

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SUMMARY

A comparison of the chemical composition of fines and coarse fibre fractions from a commercial bleached kraft pulp has been reported. The influence of fines on some sheet properties has also been determined. The fines were found to have a much higher ash and lignin content than the coarse fibre fractions. No major difference was found in the carbohydrate composition of different fractions.

The influence of fines on Sheet properties was studied by their removal as well as their addition to the same pulp. The study revealed that burst. tensile strength. etc. decrease markedly. When the fines are removed, In contrast. tearing strength which is inversely related to bonding increases with the removal of fines.

The examination of recombined pulps containing varying proportions of the coarse fibre and the fines fraction indicate that under the conditions studied the fractionation and the recombination procedure does not affect the physical properties of sheets significantly.

A very fine material is generally produced during the course of beating or mechanical treatment of pulp fibres. This material, which consists of ray cells as well as fibre fragments is known to play an important role in controlling some of the sheet properties. Early studies by Steenberg, Sandgren and Wahren[1] have clearly established the existence and importance of fines fraction in papermaking. Since then several investigators have dealt with the influence of finer fraction on the sheet properties.

The morphology and physico-chemical properties of the fines are quite different from those of the fibre fraction[2,3]. A basic knowledge of the chemical composition of fines is therefore, essential as it controls the physico-chemical behaviour of fines[4]. Fines from groundwood pulp are fairly uniform in chemical composition and they form a desirable part of the furnish but, they are very undesirable in chemical wood pulps if present in higher percentage since, they reduce the colour and strength of the pulp and tend to produce pitch trouble on the paper machine[5].

The present investigation deals with the chemical composition of whole pulp, pulp without fines and fines alone as well as the influence of fines on some sheet properties.

EXPERIMENTAL

Fractionation of Pulp :

A commercial bleached Kraft pulp from bamboo produced by Central Pulp Mills India, was used. The pulp was defiberized and fractionated in a Bauer-McNett fractionator using three different screens with mesh numbers 28, 48 and 100.

The same pulp was beaten in a laboratory valley beater to different freeness levels. The fraction beaten to 210 ml. C.S.F. was fractionated in the Bauer-McNett fractionator using the same screens as in case of unbeaten pulp.

The percentage of various fractions so obtained was determined. The results are recorded in Table-I.

TABLE—I
BAUER-MCNETT FRACTIONATION OF PULPS

	Fibre Fractionation			
	28 mesh	48 mesh	100 mesh	Passed 100 mesh
Canadian Standard freeness, 490 : Precent retained,	64.7	12.7	8.0	6.5
Canadian Standard freeness, 210 : Percent retained,	44.5	14.9	17.3	12.6

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Isolation of Fines :

The fines were isolated by fractionating the pulp (beaten to about 250 ml. C.S.F.) in the Bauer-McNett fractionator and collecting the fraction passing through the 100 mesh screen (−100). The fibre fraction retained on 100 mesh (+100) was also collected in bulk.

Chemical Composition of Fines & Coarse Fractions :

Whole pulp, fractionated pulp and fines were analysed for ash, K. lignin, Pentosans and alpha cellulose by TAPPI standard methods. The results are recorded in Table-II.

TABLE—II CHEMICAL COMPOSITION OF FINES AND COARSE FIBRE FRACTIONS

Content	Fires	Whole Pulp	Fractionated Pulp
Ash, %	2.9	0.61	0.42
Klason Lignin, %	5.8	3 3	1.6
Pentosans, %	11.2	12.4	12.9
Cellulose, %	79.7	85.8	78.7

Evaluation of whole pulp and fractionated pulp in Valley Beater :

The whole pulp and the fractionated pulp were beaten to different freeness levels in Valley beater till the final freeness was about 250 ml. (C.S.F.).

Stocks beaten to different freeness levels were made into handsheets on the British sheetmaking machine. The strength properties were determined after conditioning the sheets at 65±2% R.H. and 27± 1°C temperature. The results are recorded in Table-III.

Evaluation of Recombined Pulps :

The coarse fibre fraction (Xc) and the fines fraction (Xf) were recombined into proportions 95 : 5, 90 : 10, 85 : 15, 80 : 20 respectively. The sheets were prepared by recirculation process and the drainage time was noted. The strength properties of the artificial furnishes were also determined. The results are recorded in Table-IV.

DISCUSSION OF RESULTS

Fractionation of Pulp :

The results from the Bauer-McNett fractionation of unbeaten and beaten pulps (Table-I) indicate that there is a change in the percentage of fibres retained on screens of various mesh sizes (28, 48, 100). There is a considerable accumulation of fines (passed 100 mesh) espeeially after beating of the pulp.

Chemical Composition of Fines and Coarse Fibre Fractions :

A perusal of the data on the chemical composition of fines, whole pulp and fractionated pulp (Pulp without fines) in Table-II indicates that the fines fraction has a much higher ash and lignin content than the coarse fibre fractions. The data on the carbohydrate compositions suggests that there is no major difference in the carbohydrate distribution between the fines and the fibres. These data are similar to the data on spruce sulphite pulps obtained by Kallmes and Lindstrom et.al[4].

Influence of Fines on Some Pulp and Sheet Properties:

A perusal of Table-III indicates that with the removal of fines, the canadian standard freeness is markedly increased, coh ert as many of the strength properties of hand-sheets are slightly affected. The results discussed here are similar to those obtained by Spencer et.al[6] on bleached Sulphite Pulp.

Apparent density decreases as the fines are removed. Since the density of a sheet at the same freeness level is proportional to fibre bonding; the results indicate a decrease in bonding, either a decrease in the strength of the bonds or the number of bonds, as the fines are removed.

Bursting strength shows a decrease, as the fines are removed. Tensile strength and stretch also decreased with the loss of fines.

Tearing strength exhibits the opposite trend, as it was increased with the removal of fines. The total energy required in tearing a sheet is composed of the work required to reputure individual fibres in tension and pull individual fibres from the fibre mat. In this case, the apparent density and presumably bonding decreases with the loss of fines, hence, tearing strength would be expected to increase.

PROPERTIES OF RECOMBINED PULPS :

The properties of recombined pulps Table-IV indicate that the drainage time (Sheet formation time) increased as the proportion of fines was increased. The high drainage time on addition of fines is an indication of the high specific surface area of the fines as compared to that of fibres. During the drainage process, the fines start to behave as a gel, while the fibres allow water to drain freely between them.

TABLE—III. EFFECT OF FINES ON FREENESS AND STRENGTH (FIBRE RETAINED ON 100 MESH Vs. ORIGINAL).

Beating time (min.)	Canadian Standard freeness (CC)		Apparent density (g/cm^3)		Burst Index ($kPam^2/g$)		Tear Index ($mN.m^2/g$)		Tensile Index (N. mg)		Straetch %	
	Original	Classified	Original	Classified	Original	Classified	Original	Classified	Original	Classified	Original	Classified
0	490	615	0.55	0.52	0.70	0,50	6.81	6.76	15.56	12.47	5.28	3.57
20	445	565	0.54	0.54	0.71	0.53	7.60	6.94	14.60	14.65	5.33	4.22
40	390	510	0 61	0.58	1.23	1.06	5.71	7.54	20.65	18.58	5.50	5.22
60	310	410	0.67	0.61	1.72	1.15	4.39	7.08	28.52	22.22	5.25	5 22
80	210	270	0.70	0.63	2.27	2.10	4,64	6.34	33.92	28.90	5.07	5.54

TABLE—IV. PROPERTIES OF RECOMBINED PULPS.

Furnish : Fibree (Xe)	: Fines (Xf)	Basis weight (g/m^2)	Apparent Density (g/cm^3)	Drainage time (Sec)	Tensile index (N. mg)	Stretch (%)	Burst index ($kPan^2/g$)	Tear index ($mN.m^2/g$)
100 :	0	61.72	0.58	5.4	24.04	4.93	1.08	6.58
95 :	5	64.57	0.59	6.3	25.87	5.38	1.17	6.23
90 :	10	65.86	0.61	6.8	24.51	5.37	1.31	6.07
85 :	15	68.31	0.60	7.7	24.59	5.27	1.30	5.77
80 :	20	66.24	0.62	8.4	23.88	5.08	1.33	5.52

A perusal of Table-IV indicates that the fines when added to the fractionated pulp in lesser amount improve the physical strength properties of the sheets. Initially, there was a slight increase in apparent density, stretch, tensile index, burst index and a corresponding decrease in tear index; but, as the proportion of the fines was increased, all the properties became almost constant.

Conclusions :

1. Fines were found to have a much higher ash and lignin content than the coarse fibre fractions. No major difference was found in the carbohydrte composition of the fines and the fibres.

2. Fines when removed from the pulp, decrease apparent density, bursting strength, tensile strength and stretch of the sheets and increase canadian standard freeness and tearing strength.

3. For most of the sheet properties, the contribution of fines fraction and the fibre fraction in controlling the sheet properties could not be distinguished.

References :

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