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KRAFT PULP PROPERTIES OF FIVE SELECTED NEW ZEALAND GROWN EUCALYPT SPECIES

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SUMMARY

The kraft pulp qualities of five different eucalypt wood types are assessed.

Premium quality market kraft pulps with superior fibre properties for papermaking can be made from *E. fastigata*. This pulp will be most suitable for the manufacture of papers which require superior optical properties with good bulk, stiffness and tensile strength.

E. nitens pulps made from 15-year-old CV and NSW material show fibre properties which are roughly equivalent to those of a reference middle-of-the-road Aracruz eucalypt market kraft pulp. Such pulps can be expected to give papers of adequate-to-low bulk. *The 8-year-old E. nitens* CV pulp, on the other hand, can be expected to give papers deficient in bulk and is considered to be unsuitable as eucalypt market kraft pulp.

The 15-year-old *E. regnans* pulp can be expected to give papers of adequate bulk but poor optical properties.

INTRODUCTION

The fibre qualities of eucalypt kraft pulps determine their potential for papermaking, and these can vary greatly depending on species, growing site and provenance etc (1,2). This report details an assessment of the fibre and papermaking potentials of kraft pulps prepared from five selected eucalypt wood samples (*E.nitens* x 3, *E. regnans*, and *E. fastigata*).

EXPERIMENTAL

Sample origin

Five eucalypt samples were assessed: Three *E. nitens* and one each of *E. fastigata* and *E. regnans*. Sample details are as follows - *E. nitens* CV (8 year-old and chip basic density 463 kg/m^3), *E. nitens* CV (15 year-old and chip basic density 479 kg/m^3), *E. nitens* NSW (15 year-old and chip basic density 452 kg/m^3), *E. regnans* (15 year-old and chip basic density 426 kg/m^3), and *E. fastgata* (15 year-old and chip basic density 482 kg/m^3). All samples were from trees in the NZFP eucalypt "orchard", except for the 8 year-old *E. nitens* which was ex Kaingaroa.

The basic density of the chip samples used in the pulping trials were determined following PAPRO standard method 1.201.

The Aracruz reference market kraft eucalypt pulp from Brazil was reference material 8496 supplied by Aracruz Cellulose S.A., and distributed by National Institute of Standards and Technology, Standard Reference Materials Program, Building 202, Room 205, Gaithersburg, Maryland 20899, USA.

Pulping and bleaching

Kraft pulps of kappa number 20+/-2 were prepared from each chip sample by varying the H-factor at constant alkali charge. The pulping conditions were:

12% effective alkali as Na_2O
30% sulphidity
4:1 liquor-to-wood ratio
90 minutes to maximum temperature
170^{o}C maximum temperature

Pulps were prepared in 2.0 L Stalsvets reactors with 250 g (o.d. wt.) chip charges. Pulps were disintegrated with a propeller stirrer and screened through a 0.2 mm slotted flat screen. After dewatering and fluffing kappa number, percent rejects and total yield were determined.

Pulps were fully bleached with constant chemical charges in each stage of a DEoD sequence. Procedures used were in accordance with PAPRO standard method 1.604. Bleach conditions were: **D stage:** 0.25 active chlorine multiple, 100% industrial chlorine dioxide, 10% consistency, 50^{o}C, 60 minutes. **Eo stage:** 2.0% NaOH, 0.25 MPa O_2, 10% consistency, 70^{o}C, 60 minutes. **D stage:** 1.0% ClO_2, 0.4% NaOH, 10% consistency, 70^{o}C, 180 minutes.

Fibre dimensions

Cross section fibre dimensions of thickness, width, wall area and wall thickness were measured using image processing procedures described in detail elsewhere (3). The parameters of width, thickness and wall area are as indicated in Figure 1 for dried fibres rewetted from handsheets. The product fibre width x fibre thickness represents the minimum fibre cross section rectangle. The ratio width/thickness is an indicator of the collapse potential of the dried and rewetted fibres. The greater the width and the lower the thickness of a fibre cross section, the greater is the extent of fibre collapse. Relative numbers of fibres were calculated using the reciprocal of wall area x length. All fibre dimension measurements were made on unrefined fibres rewetted from handsheets.

Relative weighted average fibre length and fibre coarseness (fibre mass / length) were determined with a Kajaani FS 200 instrument using standard PAPRO procedure 1.306.

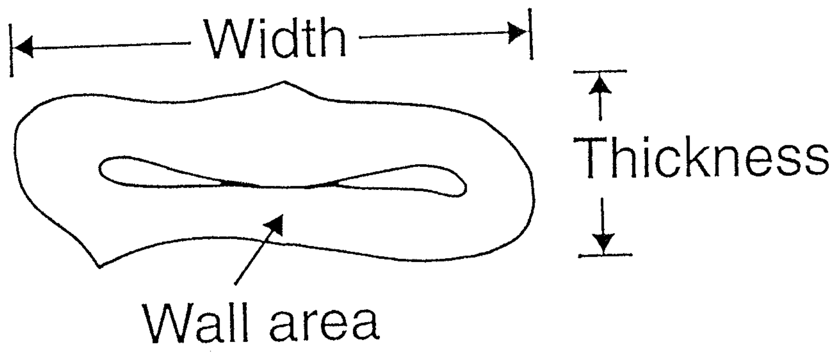

Figure 1: Schematic diagram of the cross section dimensions of fibres rewetted from handsheets

RESULTS AND DISCUSSION

Pulp yield and chip basic density

Pulp yields for the three *E. nitens* samples range from 51 to 56 percent and are unrelated to chip basic density values (Table 1). The 15-year-old *E. regnans* sample, on the other hand, is of low chip basic density with the highest pulp yield (58%). The yield of the *E. fastigata* pulp is of an intermediate level (54%).

Chip basic densities of the five eucalypt samples are unrelated to corresponding fibre length, cross section dimension, and coarseness values (Table 1). The 8-year-old *E.nitens* CV pulp is somewhat deficient in length compared with the other 4 samples.

Fibre properties and papermaking potentials

E. fastigata

The fibres of the *E. fastigata* pulp are of exceptionally low wall area (coarseness), and small (low width x thickness), narrow and uncollapsed (low width / thickness) with thick walls relative to their cross section area (width x thickness) (Figure 1, Table 1). Such fibre characteristics can be expected to give papers with excellent bulk, stiffness, tensile strength and optical property combinations (1,2). Papers made from the *E. fastigata* pulp can be expected to have exceptional light scattering properties as a result of high numbers of uncollapsed fibres in the furnish, together with good bulk and tensile strength. Finally, the *E. fastigata* fibres are unique since they show highly desirable property combinations which are absent in any

Table 1: Fibre length, coarseness and cross section dimensions

Pulp	Chip basic density (kg/m^3)	Pulp yield at Kappa 20 (%)	Length weighted length (mm)	Coarseness (mg/m)	Width (um)	Thickness (um)	Width x thickness (um)	Wall area (um^2)	Wall thickness (um)	Width / thickness	Relative number fibres
E. nitens CV 8 yrs	463	51	0.64	0.053	14.0	6.4	90.1	57.6	2.18	2.27	124
E. nitens CV 15 yrs	479	56	0.77	0.057	13.6	6.6	90.1	58.1	2.19	2.14	102
E. nitens NSW 15 yrs	452	55	0.78	0.071	13.9	6.8	96.4	60.8	2.23	2.12	96
E. regnans 15 yrs	426	58	0.81	0.076	15.6	6.8	107.1	67.6	2.28	2.38	83
E. fastigata 15 yrs	482	54	0.75	0.059	13.0	6.5	85.6	54.6	2.19	2.07	111
Aracruz	--		.76	--	13.5	6.6	89	60	2.36	2.17	100
LSD*					0.8	0.3	7.3	4.4	0.12	0.15	

*LSD: Least significant difference between means at the 95% level of significance existing market kraft pulp or any eucalypt furnish so far assessed at PAPRO. The high relative number of fibres with thick walls relative to their size ensures low collapse potential, high uniformity and exceptional papermaking potential for this *E. fastigata* pulp-type.

For many end uses the *E. fastigata* pulp has fibre properties which are superior to those of the Aracruz reference pulp, a middle-of-the-road eucalypt market pulp (Table 1) (1). Uniform populations of large numbers of slender fibres of low collapse potential are the unique attributes of eucalypt market kraft pulps. The *E. fastigata* pulp shows superior combinations of the desired fibre properties and is a eucalypt kraft pulp of premium quality.

E. nitens

The *E. nitens* CV and NSW pulps from 15-year-old trees have fibre properties which are roughly equivalent to those of the Aracruz reference pulp (Table 1), and the medium and high *E. nitens* pulps of the previous study (2). Handsheet properties and papermaking potentials of these *E. nitens* kraft pulps can, therefore, be expected to be roughly equivalent to those of the Aracruz pulp, but possibly with lower bulk.

The *E. nitens* CV pulp from 8-year-old trees consists of relatively short and wide fibres of low wall area (coarseness) and high collapse potential (Table 1). Such a pulp will give papers of high density with unacceptable bulk properties.

E. regnans

The *E. regnans* pulp consists of very wide and coarse fibres of high collapse potential. Hence, handsheets can be expected to have adequate bulk but poor optical properties because of the low relative number of fibres.

CONCLUSIONS

Chip basic density is a poor determinant of eucalypt fibre quality.

The E. fastigata pulp is of superior fibre quality which can be expected to produce premium eucalypt kraft pulps suitable for specialty and niche markets. It will be best used in the manufacture of products which require a combination of good bulk, stiffness and tensile strength with excellent optical properties.

The *E. nitens* 15-year-old CV and NSW pulps are roughly equivalent in fibre quality to the middle-of-the-road Aracruz eucalypt market kraft pulp, but will be deficient in handsheet bulk relative to the *E. fastigata* pulp of premium quality. The 15-year-old *E. regnans* pulp can be expected to have bulk properties close to those of the Aracruz furnish, but with inferior optical properties.

The *E. nitens* 8-year-old CV pulp is deficient in bulk and of questionable value as a eucalypt market kraft pulp.

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