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REFINING AND PAPERMAKING PROPERTIES OF EUCALYPT, MIXED HARDWOOD, AND SOFTWOOD MARKET KRAFT BLENDS

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Compared with eucalypt pulp, mixed hardwood pulp responds differently to refining and has inferior strength and optical properties. Mixed hardwood:softwood blends are weaker than eucalypt:softwood blends, but have equally good optical properties. Mixed hardwood:softwood and eucalypt:softwood 80:20 blends have similar properties regardless of the fibre quality of the softwood component of the blend. Mixed hardwood:softwood 80:20 blends have freeness and strength properties similarly developed whether separately refined or co-refined at 0.5 Ws/m, with co-refining at 1.5 Ws/m giving inferior results. In contrast, eucalypt: softwood blends have freeness and strength properties most developed after separate refining, with co-refining at 1.5 Ws/m giving better results than at 0.5 Ws/m.

Radiata pine and northern softwood market kraft pulps can have different refining requirements, reinforcement strengths, and optical properties, but such differences decrease with decreasing proportions of softwood fibre included in eucalypt:softwood pulp blends[1,2,3]. Thus for 80:20 eucalypt:softwood blends, refining, reinforcement, and optical properties are similar when the softwood component consists of either northern species or radiata pine pulp. It is only with refining energy demand that the 80:20 eucalypt:northern softwood blend may have an advantage over corresponding radiata pine blends. With co-refining, energy requirements are increased, reinforcement strengths (tear/tensile properties) decreased, and optical properties improved when compared with effects of separate refining.

Eucalypt market kraft pulps are known to be of high uniformity and to give papers of high bulk, stiffness, and opacity when compared with mixed hardwood pulps[4]. The present paper describes the refining and papermaking potentials of mixed hardwood:softwood blends compared with those of eucalypt:softwood blends. Market kraft pulps used in the blends include mixed hardwood from Japan, eucalypt from Brazil (Aracruz), radiata pine pulps of low (Low) and medium (Medium) coarseness, and a benchmark pulp from the interior region of British Columbia (McKenzie). Hardwood:softwood blends are in proportions of 100:0, 80:20, 50:50, and 0:100 and effects of separate and co-refining are assessed using a laboratory scale Escher Wyss conical refiner at several specific edge loads, a unit which is considered to give results indicative of commercial-scale refining operations.

Mixed Hardwood, Eucalypt, and Softwood Fibre Properties

For the mixed hardwood pulp, fibre lengths are roughly the same, fibre coarseness values are high, and relative numbers of fibres per unit mass of pulp are low, when compared with the eucalypt pulp (Table 1). Although mean fibre lengths of the eucalypt and mixed hardwood pulps are roughly the same, corresponding population distributions are very different[5]. The mixed hardwood pulp has the broadest distribution of fibre lengths and the highest proportion of fines—about 2% weighted by length compared with 0.2% for the eucalypt pulp.

The Medium and McKenzie pulps have almost identical mean fibre lengths but very different coarseness values (Table 1). In contrast, the Low pulp contains shorter fibres of coarseness intermediate between those of the Medium and McKenzie furnishes. As expected, the eucalypt and mixed hardwood fibres are roughly one-third the length and coarseness of the softwood fibres.

Table 1: Fibre length and coarseness, and numbers of fibres

Pulp	FS-200 fibre length* (mm)	FS-200 fibre coarseness (mg/m)	Relative number of fibres
Eucalypt	0.76	0.075	940
Mixed hardwood	0.78	0.096	715
Low	2.26	0.237	100
Medium	2.50	0.271	79
McKenzie	2.49	0.176	122

*Length weighted

Pulp and Blend Refining Properties

The eucalypt and mixed hardwood pulps, when processed alone, show similar trends in their response to refining. Treatment at 0.5 Ws/m is most effective, and at 2.5 Ws/m least effective, in developing tensile strength (Figure 1). Throughout the refining range, the mixed hardwood pulp has lower tensile strength than the eucalypt pulp.

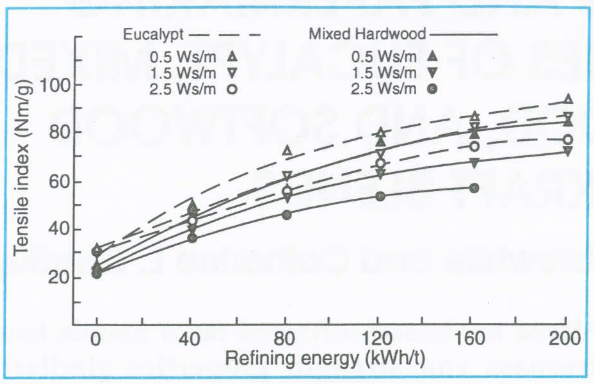

Figure 1: Tensile strength/refining energy for mixed hardwood and eucalypt pulps refined at three specific edge loads

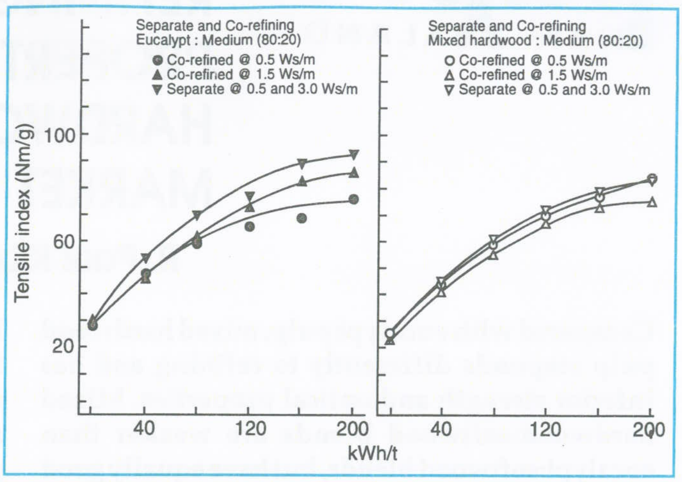

Figure 2: Tensile strength/refining energy for Medium blends

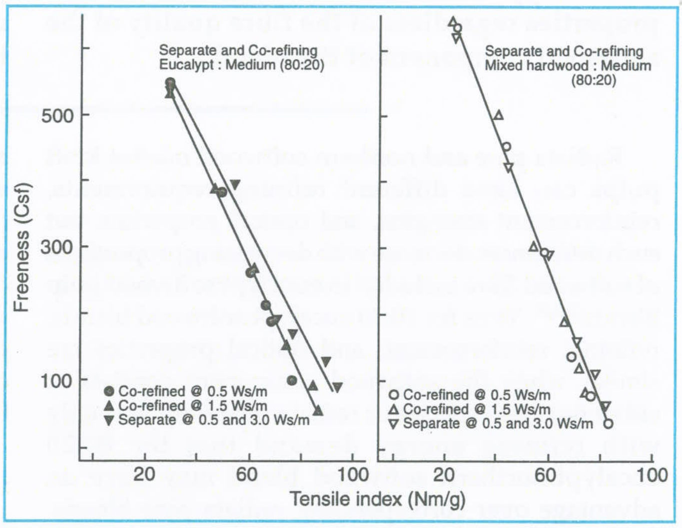

Figure 3: Pulp freeness/tensile strength for Medium blends

The tensile strengths of 80:20 mixed hardwood: softwood blends are similar when pulps are refined separately at 3 Ws/m (softwood) and 0.5 Ws/m (hardwood), or co-refined at 0.5 Ws/m specific edge load (Figure 2)[5]. Co-refining at 1.5 Ws/m is less effective in developing tensile strengths. These effects contrast with those of eucalypt:softwood blends where separate refining is clearly most effective in developing tensile strength, and co-refining at 1.5 Ws/m is more effective than treatment at 0.5 Ws/m. Furthermore, tensile strengths of 80:20 eucalypt:softwood blends are always substantially greater than those of corresponding mixed hardwood:softwood blends. Similar trends are obtained when the softwood component of a blend is of McKenzie, Low, or Medium pulp origin[5].

Freeness/tensile strength relationships are essentially the same for both separate and co-refined mixed hardwood:softwood blends (Figure 3)[5]. For the eucalypt:softwood blends, on the other hand, separate refining is most effective in developing tensile strength for given freeness values. Furthermore, freeness/tensile relationships are the same and independent of softwood type for both the 80:20 eucalypt:softwood and mixed hardwood:softwood blends[2,5].

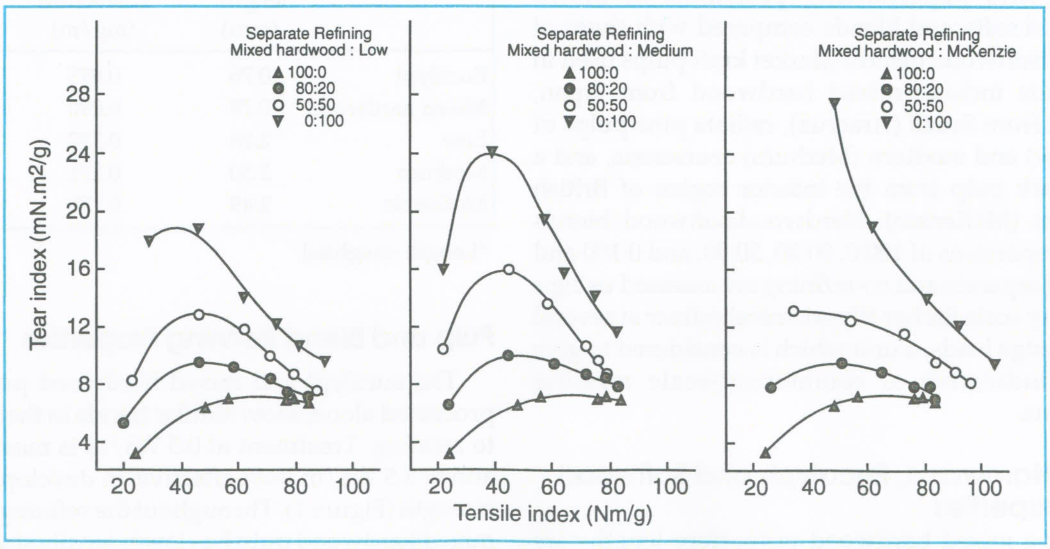

Figure 4: Mixed hardwood:softwood blend reinforcement strengths—separate refining

Handsheet Reinforcement Properties

For the 80:20 mixed hardwood: softwood blends, furnish reinforcement strengths or tear/tensile relationships are roughly the same and independent of the origin or type of softwood used (Figure 4). Thus, softwood fibre quality differences have negligible effects on the web reinforcement properties of 80:20 mixed hardwood:softwood blends. For the 50:50 blends tear/tensile strength differences between the three softwood types are also very much decreased but tear strengths remain higher for the Medium blend. Similar trends occur with the eucalypt:softwood blends. As shown in Figure 5, the mixed hardwood pulp has a markedly lower tear strength than the eucalypt pulp[5]. This effect increases with increasing proportions of mixed hardwood fibre, as expected.

Co-refining is only marginally less effective than separate refining in developing the tear strength of 80:20 mixed hardwood:softwood blends (Figure 6). This effect is independent of the softwood fibre type used, and is markedly less than that obtained with corresponding eucalypt:softwood blends[3,5].

Handsheet Optical Properties

Light scattering coefficients at given handsheet tensile strengths decrease as increasing proportions of softwood are included in the mixed hardwood:softwood blends (Figure 7). This is less marked with the mixed hardwood than with the eucalypt blends since the light scattering coefficient of the mixed hardwood pulp before blending is lower than that of the eucalypt pulp but changed only slightly by the addition of 20% softwood fibre to the furnish (Figures 7 and 8)[5]. Hence, the differences in light scattering potential of eucalypt and mixed hardwood pulps are greatly reduced when blended with 20 or 50% softwood fibre. The 80:20 and 50:50 eucalypt:softwood blends have light scattering properties roughly equivalent to those of corresponding mixed hardwood:softwood blends[2,5]. Again, the influence

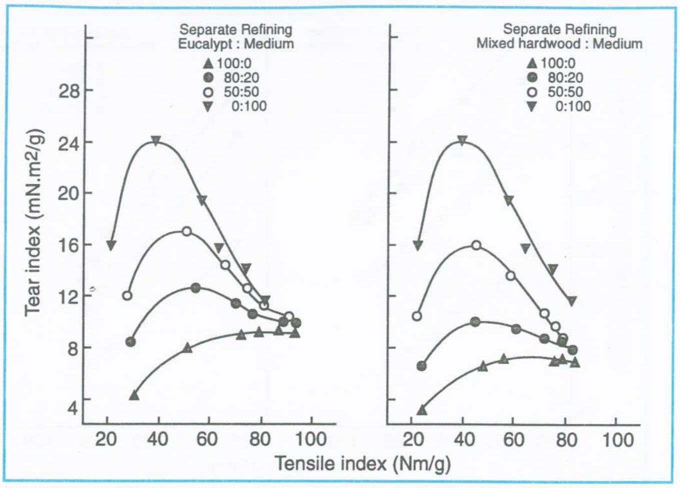

Figure 5: Reinforcement strengths for Medium blends—separate refining

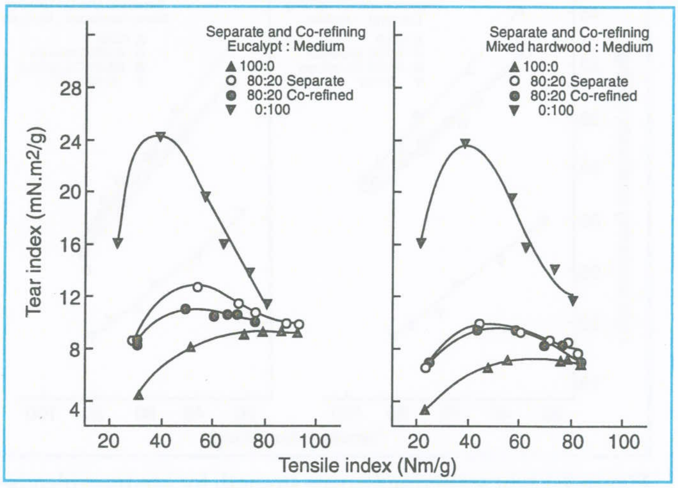

Figure 6: Reinforcement strengths for Medium blends—co-refining

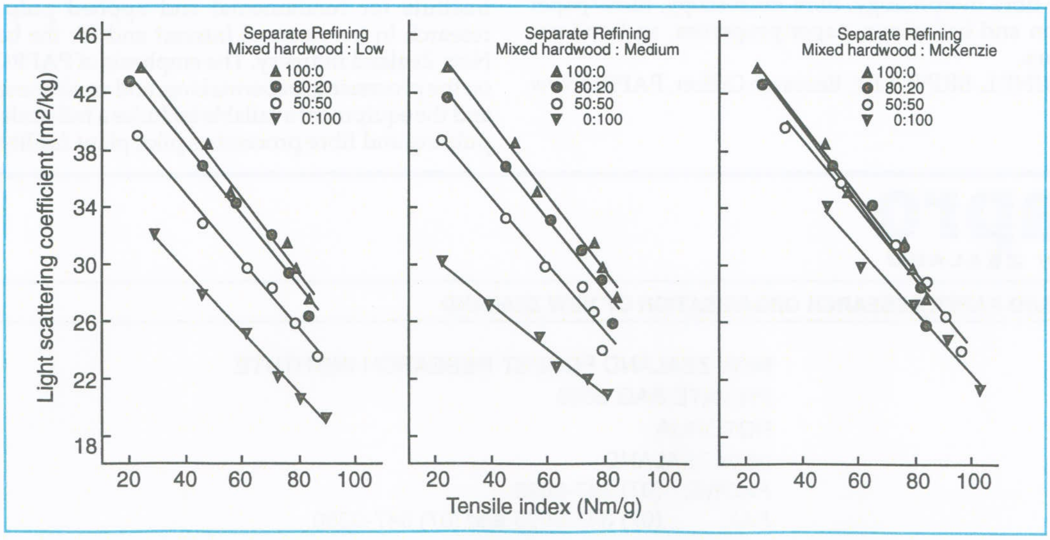

Figure 7: Mixed hardwood:softwood blend optical properties—separate refining

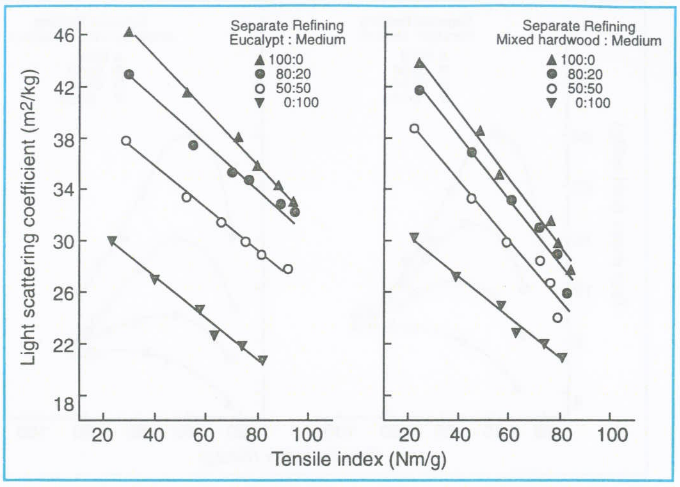

Figure 8: Light scattering/tensile strength for Medium blends—separate refining

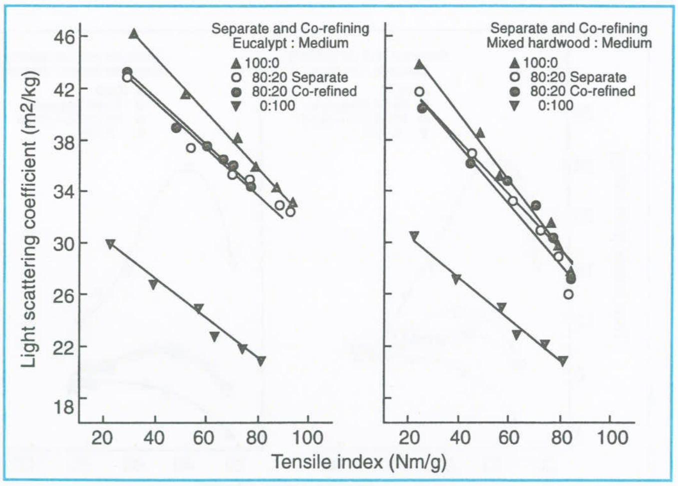

Figure 9: Light scattering/tensile strength for Medium blends—co-refining

of softwood fibre quality is reduced as increasing proportions of mixed hardwood fibre are included in the furnish, and at the 80:20 (and 50:50) level the three different mixed hardwood:softwood blends have similar light scattering properties, closer even than those of the 80:20 eucalypt:softwood blends[3,5].

For 80:20 mixed hardwood:softwood blends, light scattering coefficients are marginally higher with co-refining at 0.5 Ws/m than with separate refining (Figure 9). This effect is independent of softwood fibre type since similar values are obtained with the Medium, Low, and McKenzie mixed hardwood:softwood blends[5].

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