PULP AND PAPER FROM OIL PALM FIBRES

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INTRODUCTION

Malaysia is the leading producer of palm oil with about 52% of the world's palm oil production and 8.7% of world's oils and fats production. To maintain the competitive edge of the industry, a number of strategies have been adopted, one of which is the zero-waste strategy. This involved the conversion of oil palm residues, which is actually oil palm biomass, into value-added products, such as pulp and paper, and medium density fibreboard. Earlier collaborative research between GIRIS (Government Industrial Research Institute, Shikoku) and PORIM, and quite recently between PORIM, FELDA and Oji Paper demonstrated that fibres from oil palm frond (OPF), oil palm trunk (OPT) and empty fruit bunches (EFB) could be used to produce pulp and paper of high quality.

SOURCE OF OIL PALM BIOMASS

With the current and future extensive replanting programmes, massive amounts of oil palm biomass are made available for utilisation. For instance, between 1997 to 2000, the total estimated amounts of available OPT, OPF and EFB are 4.34, 2.99 and 3.08 million tonnes dry weight respectively.

CHARACTERISTICS OF FIBRES FROM EMPTY FRUIT BUNCHES, OIL PALM TRUNKS AND FRONDS

Of the three types of oil palm fibres, the fibre from EFB is the shortest, narrowest and smallest (*Table 1*). The fibre length distribution shows that the amount of short fibres (<0.5mm) is high in the EFB pulp. Further, it also has the narrowest lumen width. The morphological properties reveal that the EFB fibre resembles greatly the short-fibred hardwoods like eucalyptus. The high number of fibres per unit weight indicates that the paper made from the EFB fibres would have exceptionally good printing properties and good formation in paper making. Although the fibre length of both OPT and OPF is intermediate between hardwood and softwood, this characteristic is affected by high fines (parenchyma) content; parenchyma contents in trunk and frond are about 50% and 30% respectively, versus about 5% in the EFB.

Table 1. Morphological properties of fibres from oil palm, hardwood and softwood

	EFB	Frond	Trunk	Hard-wood	Soft-wood
Length weighted avg. fibre length (mm)	0.67	1.03	1.37	0.83	2.39
Width of fibre (μm)	12.5	15.1	20.5	14.7	26.8
Width of lumen (μm)	7.9	8.2	17.6	10.7	19.8
Runkel ratio	0.59	0.84	0.26	0.37	0.35
Area of fibre (μm)	75.6	126.2	86.7	79.0	256.1

PROCESSING OF OIL PALM BIOMASS INTO PULP AND PAPER

There are many methods of cooking the biomass to release the fibres but for the purpose of this paper, only two are described. The first is the Kraft Pulp (conventional method) and this involves the digestion of the biomass with white liquor (sodium hydroxide and sodium sulphide) at 165°C for three hours. The second method is Kraft Anthraquinone (also known as Soda AQ), and this is conventional pulping which incorporates anthraquinone as an additive to accelerate the pulping process and to improve the strength of the fibres. The duration and temperature of cooking are critical in ensuring the strength of the fibres because both overcooking and overheating will reduce the strength of the fibres. The reaction during cooking dissolves most of the lignin from the oil palm biomass and this lignin is retained in the black liquor. The residual product is the fibres which at this stage still contains some lignin. It is subsequently removed by a sequence of bleaching. The final product is the pulp whose properties must match those of the bleached hardwood kraft pulp (BHKP) to produce high quality paper.

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PAPER MAKING PROPERTIES OF BLEACHED PULPS FROM OIL PALM BIOMASS

Of the three types of pulp from the oil palm biomass (*Table 2*), the one with the most promising profile is the EFB pulp because of the following paper properties:

- Good tear strength
- Good beatibility
- Excellent opacity
- Good bulk and good fold
- Good formation

ECONOMIC FEASIBILITY OF EFB PULP

Malaysia consumed about 620 000 tonnes of paper making fibres in 1994 of which recycled fibres constituted almost 65% of the total. Consumption of BHKP totalled 25 000 tonnes in 1995 and represented about 4% of total paper making fibre consumption in the country. Demand for BHKP is expected to increase from 25 000 tonnes in 1995 to 170 000 tonnes by the year 2010, corresponding to an average growth rate of 16% per year or about 10 000 tonnes per year.

In 1995, the Asia-Pacific region produced 2.207 million tonnes of BHKP and consumed 4.305 million tonnes of BHKP, hence accounting for imports which were approximately 66% of total consumption with the major importers being Japan, Korea, and Taiwan. By 2010, consumption of BHKP in Asia-Pacific would increase to 8.407 million tonnes.

In the late 1980's, there was a strong pulp demand and prices increased to US$ 840/tonne. However, in early 1990s, there was a world-wide economic slow down and pulp prices declined to reach its bottom in 1993 (about US$400/tonne) after which prices increased to level at US$ 875-925/tonne in 1995. Prices are forecast to be around US$ 700/tonne in the year 2000.

INVESTMENT

Capital requirements for investing in a 500 tonnes/day pulp mill utilising EFB would require approximately US$ 340 million.

COST COMPETITIVENESS

The EFB pulp has to compete heavily with BHKP and to some extent from non-wood producers. The BHKP are mainly utilised for the production of commodity grade papers, which are wood-free. Because the commodity paper producers are integrated as an industry, the market is difficult to penetrate. A more promising option is to target for specialty paper producers because of favourable factors which include non-integrated pulp production, high users of non-wood fibres and willingness to experiment with non-wood fibres.

The types of specialty paper products that can be produced from EFB pulp include:

- Thin, high quality printing paper
- Specialty papers such as cigarette and photographic papers
- Security papers
- Substitute papers for cotton, hemp and kenaf pulp in some paper grades.

At the forecast price of between US$ 450-700/tonne in the year 2000, the selected producers as shown would still be able to cover their manufacturing costs (the cost to produce a tonne of EFB pulp is estimated at US$ 300). Margins would grow considerably as the price level increases.

Table 2. Sheet Properties of Bleached Kraft Pulp (60 g/m³)

PFI (rev)		C.S.F (ml)	Opacity (%)	Density (g/m²)	Tear (mNm²/g)	Breaking (km)	Burst (kPam²/g)	Folding (time)	Air Permeability (sec.)	Smooth (sec.)	Rigid (mN)
EFB	CEHD 1000	515	80.6	0.63	11.7	4.8	4.5	107	10	9	0.53
FROND	CEHD 1000	370	85.8	0.65	12.7	7.3	5.6	367	56	5	0.85
TRUNK	CEHD 1000	510	68.8	0.60	12.0	6.4	4.6	165	16	2	0.80
Hardwood	CEHD 3500	450	74.1	0.63	9.5	6.5	4.5	58	15	4	0.94
Softwood	CEHD 3300	560	62.7	0.64	13.1	7.9	7.6	1200	22		1.10

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