

A photograph of an oil palm plantation with a dirt path leading through the trees. The palm fronds are dense and green, with some brown fronds visible. The sky is blue with some light clouds.

UTILISATION OF OIL PALM BIOMASS FOR VARIOUS TYPES OF PULP

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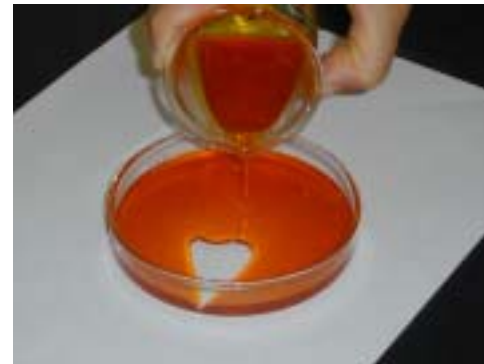
**Collaboration
under MoU
since 1995**

**Research fellow:
1998~2001**

**Topics:
Utilisation of Oil Palm
Woody Biomass**

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OIL PALM



ON THE OTHER HAND...

Lignocellulosic biomass from oil palm is not fully utilised. Many of them are just discarded or burnt.



Dumped at plantation sites

Causing air pollution



Oil Palm Lignocellulosic Biomass



Empty fruit bunch (EFB)

Left after removal of the fruits;
almost lignocellulose

4 million t/yr



Frond (OPF)

Pruned when collecting the fruit
bunches; the stalk part contains
carbohydrates as well as
lignocellulose

24 million t/yr



Trunk (OPT)

Discarded for replantation after
25~30 years of the oil
production; it consists of vascular
bundles and parenchyma

3 million t/yr

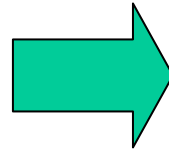


Kernel shells
Fruit fibres

Ref. Wood production in Japan: 8 million t/yr

TARGET: Material

Empty Fruit Bunches (EFB)

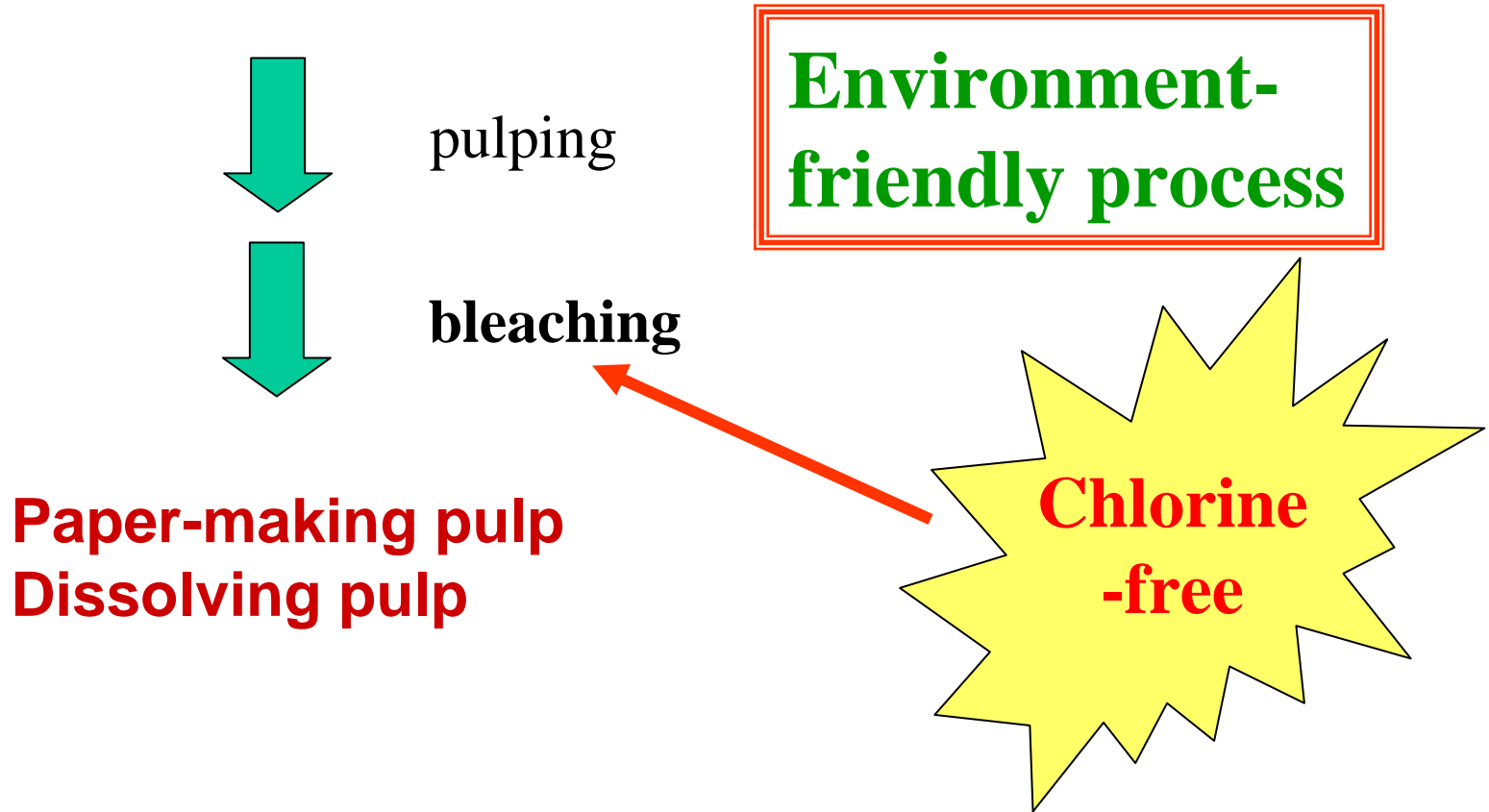


defibrization



- Regularly discharged and collected at PO mills
- Similar to wood component
(holocellulose 70%, lignin 17%, ash 1%)

Preparation of various types of pulp



TOTALLY CHLORINE-FREE (TCF) BLEACHING OF EFB CHEMICAL PULP



EFB Chemical Pulp - TCF bleaching process

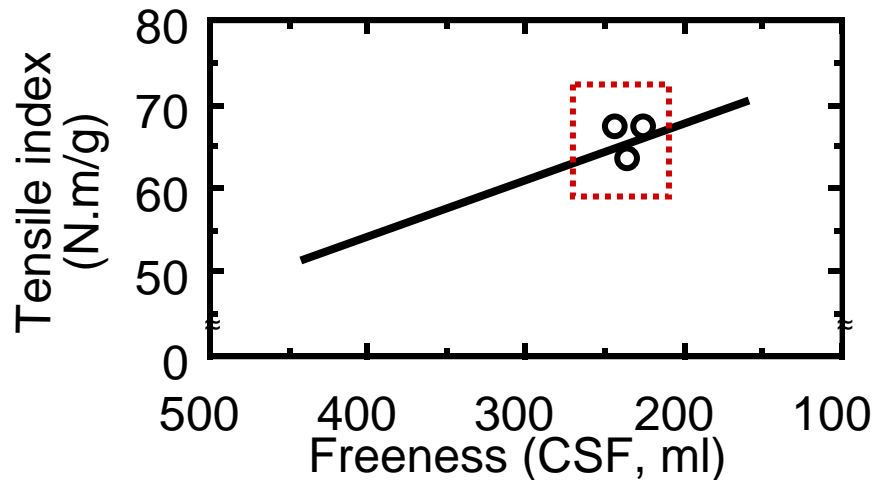
Oxygen (O₂) / Acid / Ozone (O₃) / Hydrogen peroxide (H₂O₂)

Brightness of TCF-bleached EFB chemical pulp

Pulping method	Brightness (%)
Kraft	73.9 ~ 80.4
Kraft-AQ*	79.6
Soda-AQ*	80.9
Standard printing paper	80~90

*AQ = anthraquinone

Paper strength of EFB kraft pulp



— Bleached hardwood KP

(Indication of fibre bonding density after beating process: Low ↔ High)

Conclusions

EFB chemical pulp can be bleached by a chlorine-free process to obtain brightness of 75~80% with paper quality comparable to hardwood KP.

Totally chlorine-free (TCF) bleaching method can be applied to EFB chemical pulps and EFB is suitable as a raw material of chemical pulp.

Assuming.....

4 million t/yr EFB x 40% pulp yield →

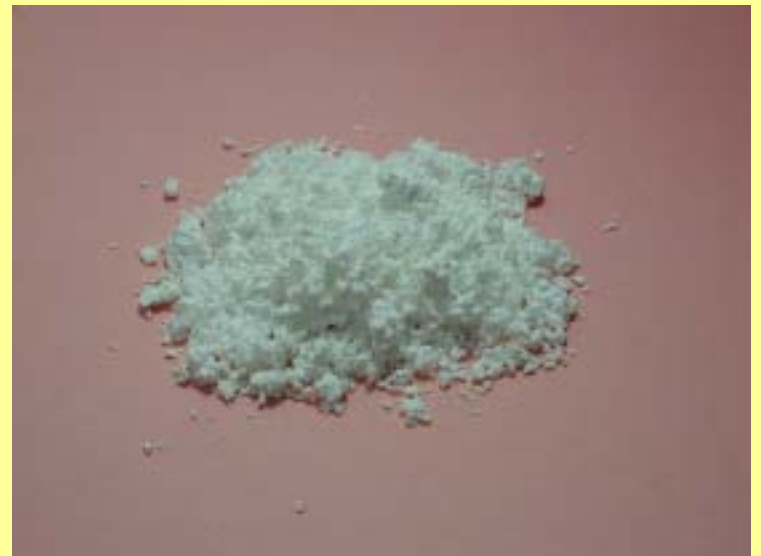
1.6 million t/yr of paper & paper boards production

Current situation:

domestic demand in Malaysia = 1.8 million t/yr, 60% imported

The world trend in pulp bleaching is toward the reduction of chlorine-related compounds because of environmental concern. Once the oil palm by-product becomes a raw material for pulp production in industrial scale, it must be essential to develop environmentally friendly bleaching processes in future.

DISSOLVING PULP FROM EFB



Usage of Dissolving pulp (DP)

Highly purified cellulose pulp

Cellulose derivatives

Cellulose acetate

Cellulose nitrate

Carboxymethyl cellulose

Methyl cellulose

Regenerated cellulose

Microcrystalline cellulose

films, eyeglass frames, cigarette filters

smokeless powder

water-soluble thickener, dispersant

thickener, plastic

fibers, rayon, cellophane



Preparation of DP

Sequence : Acid pre-hydrolysis - Pulping - Bleaching (ozone) - Alkali extraction

Chemical properties

Preparation condition	α -cellulose content (%)	Ash content (%)	Pentosan content (%)	Viscosity (cp)
Pre-hydrolysis - pulping - ozone - alkali extraction	95.1	0.09	1.8	5.2
Control (no pre-hydrolysis)	77.9	0.12	24.2	4.4
Commercial softwood DP	92.3	0.14	2.5	10.4

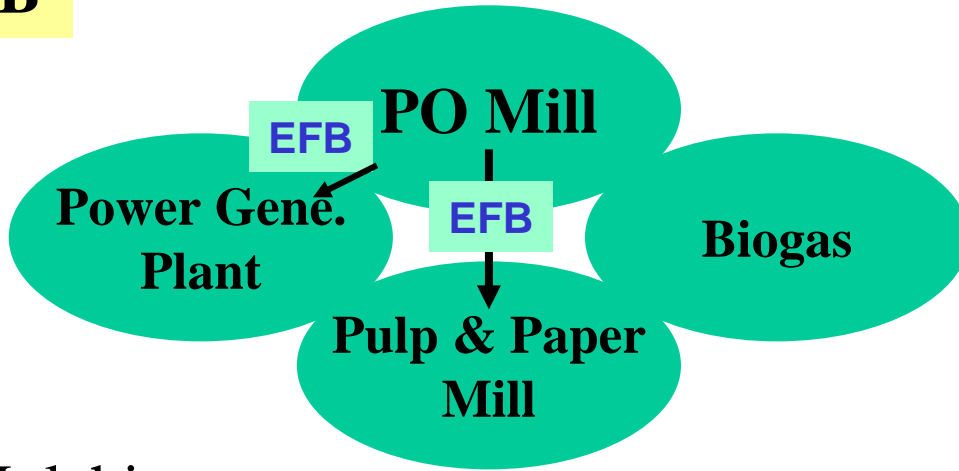
Conclusions

Combination of acid pre-hydrolysis, soda-AQ pulping and TCF bleaching is effective for producing dissolving pulp from EFB.

EFB has significant potential as a raw material to be utilised for dissolving pulp in an environmentally friendly manner.

EFB has a great potential as a raw material for both paper-making pulp and dissolving pulp. It may lead to sufficient supply of paper as well as establishment of cellulose-related industries in Southeast Asia.

EFB



Palm oil mill
+
Total Biomass
Utilisation System

Mulching



Fertilisers



Composites
(EFB + polymer)

FRONDS



Animal feeds

TRUNKS



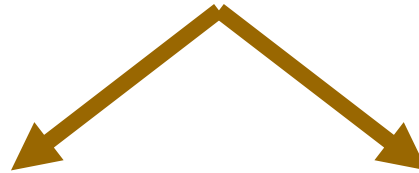
Plywood

Furniture

Unused or Underutilised Woody Biomass



How to use them?



ENERGY RESOURCES

High demand
Renewable energy

MATERIALS

- **Natural polymers**
- **Their physical structures should be fully utilised.**

Feasibility Studies on Woody Biomass in ASEAN Countries

under ASEAN Biomass Research Strategy



THANK YOU FOR YOUR KIND ATTENTION