

LIGNO-RIPPER MACHINE FOR PROCESSING OF FIBROUS BIOMASS

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The 5 million hectares of oil palm plantations in Malaysia, produces over 18 million tonnes of crude palm oil and 80 million tonnes of biomass a year. Biomass from the oil palm industry includes the trunks (OPT), fronds (OPF), shells, empty fruit bunches (EFB), mesocarp pressed fibre (MPF) and palm oil mill effluent (POME). About 18 million tonnes, of EFB are obtained from about 80 million tonnes of total biomass produced. Presently, the EFB is mainly used as mulch, but the economics are marginal due to the high transport and handling costs. There has been value-added applications of EFB in compost, bio-composite and bio-based chemicals. One of the issues in commercialising the EFB is its processing into fibres for the specific sectors.

OBJECTIVES

The Ligno-Ripper was developed to cut the size of lignocellulosic material namely EFB, oil palm hard bunch, oil palm sterilised bunch, OPT, OPF and any lignocellulosic materials, e.g. kenaf to form particles and individual strands of vascular fibre. This Ligno-Ripper (Figure 1) functions as

a pre-treatment process to produce short fibre of length size between 9 mm to 50 mm. Currently, to produce strands fibre/individual long fibre (50 mm to 203 mm), several machines need to be used namely a shredder machine, bunch press and hammer mill. However, to produce short length fibre (< 50 mm) for various downstream applications, the long fibre must be first shredded in a machine like hammer mill that will invariably increase the production cost. Production of short fibre (< 50 mm) using this invention will eliminate the use of shredder machine and hammer mill.

The lignocellulosic materials produced using this machine (Figure 2) have the characteristics that make them suitable for used as feedstock for renewable energy: solid fuels (briquettes and pellets) and second generation biofuels (bioethanol, bio-oil and bio char). Alternatively, they can also be composted with POME to produce bio-compost. Short fibres from EFB, OPT, OPF and kenaf are commercially used for bio-composite and agro products such as pulp and paper, particleboard, medium density fibreboard (MDF), pellets for energy and animal feed.

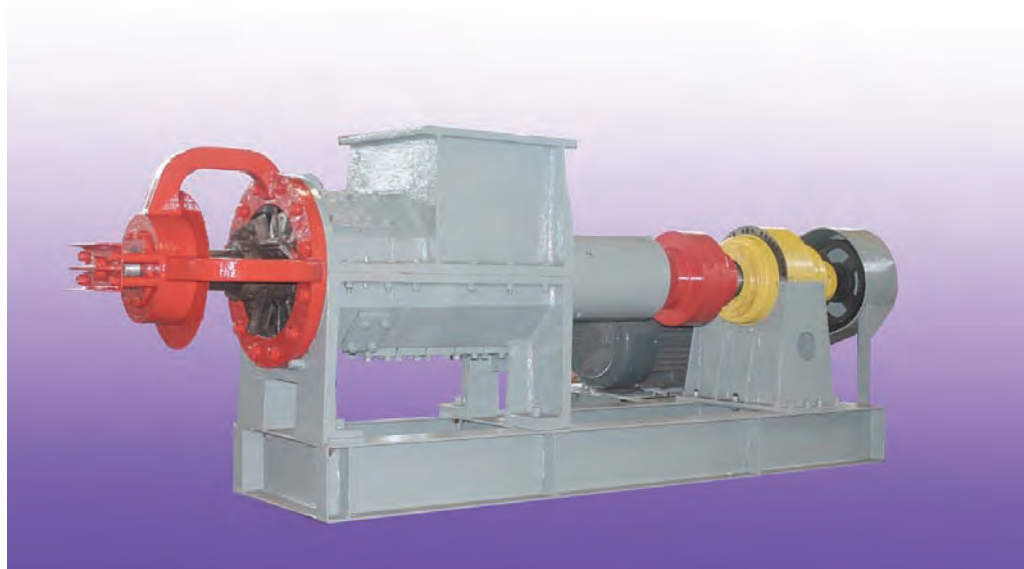


Figure 1. Ligno-Ripper machine.

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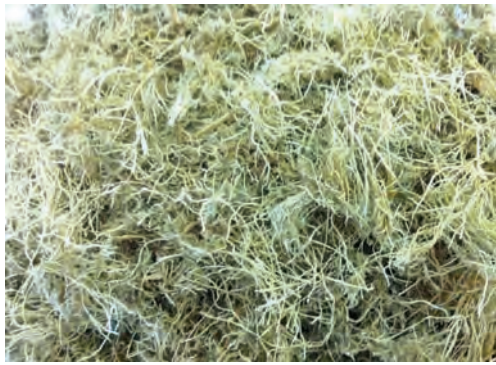


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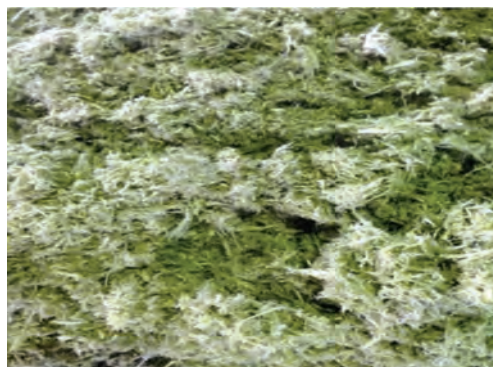




Lignocellulosic of oil palm EFB



Lignocellulosic of OPF



Lignocellulosic of kenaf



Lignocellulosic of OPT

Figure 2. Lignocellulosic material after the Ligno-Ripper machine process.

TECHNOLOGY

- This technology relates to a specially designed cutting system to cut the lignocellulosic material into different lengths using a shearing process through a combination of two fin cutter, fixed knife and different sizes of dye plate.
- The clockwise rotation of the shaft brings forward the short length/pulverised material to the fixed dye plate, extrudes the lignocellulosic material and cuts it into smaller sizes using a blade.
- Design capacity: 40 t hr⁻¹ palm oil mill.

LIGNO-RIPPER MACHINE SPECIFICATION

1. EFB throughput	: 7-8 t hr ⁻¹
2. Revolution per minute (RPM)	: 60-70
3. Motor	: 150 hp/ 110 kW
4. Gearbox type	: Sumitomo or equivalent
5. Bearing type	: SKF or equivalent
6. Cutter and fixed knives	: Cast steel c/w hard facing
7. Casing	: Cast Steel c/w hard facing
8. Main shaft	: EN16 carbon steel shaft

ECONOMIC FEASIBILITY

With the capacity to process 8 t hr⁻¹, the Ligno-Ripper machine can process 1600 t of EFB per month or 19 200 t yr⁻¹. The investment cost is estimated at RM 218 000 (including machine and other costs). A pre-tax income of RM 106 453 per year can be generated if the production of lignocellulosic materials is 19 200 t yr⁻¹. On average, the unit cost of production is estimated at RM 18 t⁻¹. Using a 10% discount rate and a selling price of RM 25 t⁻¹, commercial production of EFB fibre using the machine is attractive with a payback period (PBP) of three years (Table 1). The commercial venture is expected to yield a Benefit Cost Ratio (B:C) of 1.18, Net Present Value (NPV) of RM 383 938 and Internal Rate of Return (IRR) of 44.31%. As the B:C is greater than unity, NPV is positive and IRR is greater than the opportunity cost of capital, the investment proposition is financially feasible.

TABLE 1. VIABILITY PARAMETER

Price (RM t ⁻¹)	Discount Rate at 10%			
	IRR (%)	NPV (RM)	B:C	PBP (yr)
25	44.31	383 938	1.18	3

COMMERCIAL BENEFITS

- Low maintenance cost of RM 0.12 t⁻¹ FFB processed.
- Low maintenance cost of RM 0.17 t⁻¹ frond and trunk processed.

INTELLECTUAL PROPERTY

- A Malaysian patent pending PI 2013001152.
- Intellectual property is shared between MPOB and Hur Far Engineering Works Sdn Bhd.
- The technology is licensed to Hur Far Engineering Works Sdn Bhd.

COMMERCIALISATION

This Ligno-Ripper machine was sold to a palm oil mill in Malaysia for a biomass related project. Many enquiries for this machine for various applications have been received from Malaysia and other countries such as Indonesia, the Philippines and Thailand.

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