



Cooperation in Pyrolysis of Empty Fruit Bunches

Memorandum of Understanding - August 2011

Palm Oil Industry

- ▶ Dynamotive and Genting Bio-Oil are looking at the palm oil industry which generates significant biomass in the form of Empty Fruit Bunches (EFB's).
- ▶ Both Companies have experience in pyrolysis and in the processing of EFB's.
- ▶ By pooling know how the companies aim to take a leading position in the sector.
- ▶ The Companies entered into a non binding MOU to explore development in South East Asia



Palm Oil Industry

2.65 million hectares under palm oil cultivation. Each hectare produces 10,000kg of fresh fruit bunches annually.



This gives an output of over 5.8 million tonnes of EFB annually which potentially can be processed into pyrolysis oil and bio char.

Empty Fruit Bunches

Previous tests using Empty Fruit Bunches (EFB's) in the fast pyrolysis process revealed results consistent with other feedstocks

EFB Analysis	Unit	Methods	Dry Palm Fruit
Ash @ 750°C	%, dry basis	ASTM D-3172	7.41
Carbon, C	%, dry basis	ASTM D-5373	45.50
Hydrogen, H	%, dry basis	ASTM D-5373	5.78
Nitrogen, N	%, dry basis	ASTM D-5373	0.76
Oxygen, O (by difference)	%, dry basis		40.00
Total chloride content, Cl	%, dry basis	ESM 360B/040C	0.45
Total sulfur content, S	%, dry basis	PAPTAC G28	0.10
Total	%, dry basis		100.00

Palm Fronds

Palm Fronds have also been tested at a commercial scale yielding the following through the Fast Pyrolysis Process, and serve as an alternative feedstock:

Product	Yields (wt%)	Mass Flow Rate
BioOil	51%	2550
Charcoal	33%	1650
NCG	16%	800

BioOil Properties	Value	Unit
Density	1200	kg/m ³
High Heating Value	16.3	MJ/kg
Lower Heating Value	14.6	MJ/kg
Specific Heat Capacity	2.09	kJ/kg °C
Thermal Conductivity	0.35-0.43	W/mK
Surface Tension	39	mN/m
pH	2.5	
Flash Point	50	°C
Pour Point	(-20) - (-33)	°C
Ignition Temperature	600 - 700	°C
Vapour Pressure	5.2 @ 33.5°C	kPa

MOU Objectives

- ▶ Obtain knowledge of pyrolysis oil production market and its development potential in South East Asia.
- ▶ Ascertain the performance and commercial viability of Dynamotive Pyrolysis Technology, with respect to empty fruit bunch (EFB) a residue from palm oil production process as feedstock.
- ▶ Evaluate the possible business opportunities for the construction of a commercial biofuel plant, including biomass quantification, characterization and evaluation for use in pyrolysis process, biofuel production, supply chain and plant location.
- ▶ Evaluation of the collaborative business model between the parties.
- ▶ Subject to meeting MOU objectives establish definitive commercial agreements.



Dynamotive Energy Systems Corporation