

Waste Management: Value-Added Products From Oil Palm Empty Fruit Bunch (EFB) After Treatment



by Ir. Hor Kok Luen

Ir. Hor Kok Luen graduated from University of Science Malaysia (USM) in 2001 with Bachelor Degree (Hons.) in Mechanical Engineering. He is currently chief engineer of a established palm oil group involved in palm oil mill processing, long fibre plant, short fibre plant, solvent extraction plant, biogas capturing plant and of green energy generation for grid connection.

He is a corporate member of The Institutions of Engineers Malaysia (IEM) in Mechanical discipline and a registered Professional Engineer with the Board of Engineers Malaysia (BEM). He is currently a committee member of Food & Agricultural Engineering Technical Division (AFETD).

In palm oil mill processing, Oil Palm Empty Fruit Bunch (EFB) is treated as biomass waste. Currently, with the correct approach, matured engineering and technology innovations, this biomass waste can be further processed and treated as a value-added product which can generate profits.

These products are mainly dried long palm fibre, short loose fibre and pressed EFB liquor. Dried long palm fibre makes a good substitute for coconut fibre in furniture industries (e.g. mattress fibre and cushion production). Short loose fibre can be turned into fuel in the solid fuel boiler (volatile matter at 40% maximum). The liquid based product, pressed EFB liquor, is the main source for Chemical Oxygen Demand (COD) enhancement for boosting the formation of methane gas, capturing renewable energy and power generation.

This paper briefly elaborates, with a clearer scope, about the value-added products which are a significant new milestone for downstream activities in conventional palm oil mill processing.

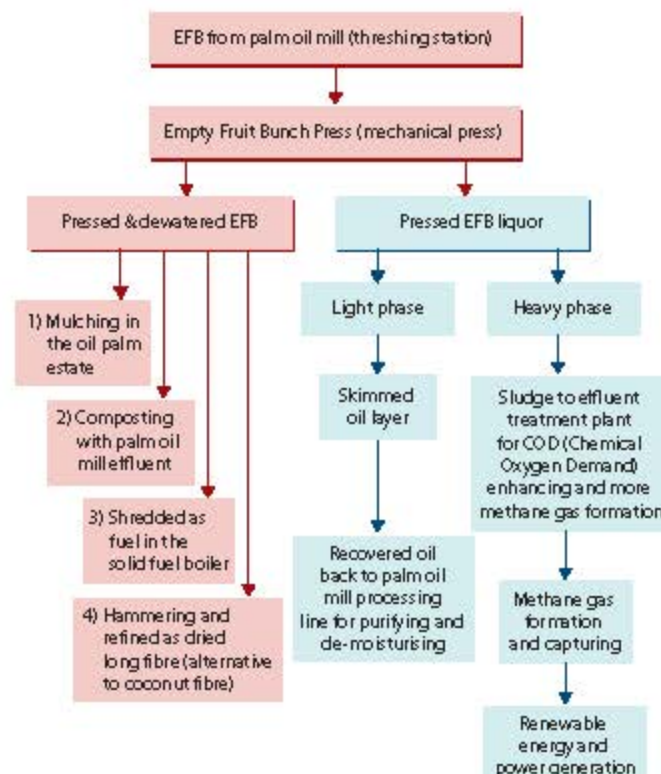
PROCESSING OF EMPTY FRUIT BUNCH

In a simple mass balance analysis, the composition of the Empty Fruit Bunch (EFB) is typically about 21% of the overall Fresh Fruit Bunch (FFB). Oil Palm EFB used to be treated as biomass waste in the palm oil mill processing. Handling and disposal of EFB was a serious problem and a great challenge to the industry. If not handled properly, it has a huge, negative impact on the environment. Currently, this oil

palm biomass waste is further processed to produce value-added products.

Below is a typical EFB treatment process flow chart which is used in most palm oil mills today. It is becoming more popular as the related machines are now more mature in design, with user-friendly operations and maintenance and well as safe to use. As illustrated, after the treatment of the EFB, there are various downstream activities for producing value-added products. These value-added products can be commercialised while the related production lines are practical and workable.

EMPTY FRUIT BUNCH TREATMENT AND VALUE-ADDED PRODUCTS FLOW CHART

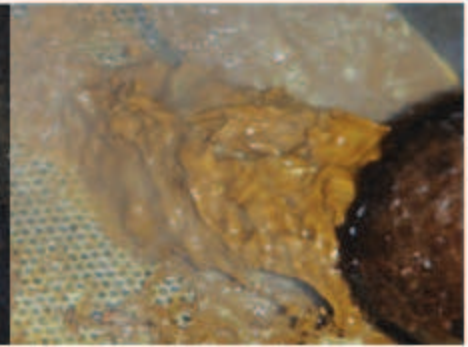




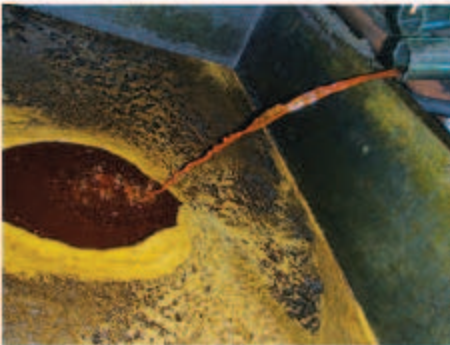
EMPTY FRUIT BUNCH (EFB)



PRESSED EMPTY FRUIT BUNCH (PEFB)



PRESSED EFB LIQUOR



RECOVERED OIL FROM PRESSED EFB LIQUOR



SHORT LOOSE FIBRE AS BOILER FUEL



DRIED LONG FIBRE



BIOGAS PROJECT-METHANE GAS CAPTURING



COMPOSTING PROJECT



EFB MULCHING IN THE ESTATE



RAW EFB AND SHREDDED EFB

From the EFB treatment flow chart and photographs as illustrated here, the value-added products are explained briefly below.

EFB FROM PALM OIL MILL (THRESHING STATION)

Conventionally, the sterilised oil palm fruitlets attached to the bunch must be detached, threshed and recovered through processing. The non-fruitlets bunch is called the Empty Fruit Bunch (EFB). The EFB will be separated and treated as biomass waste.

APPLYING EFB PRESS WITH GOOD & MATURED ENGINEERING DESIGN

The EFB removed from thresher will be fed to the bunch press for further treatment (pressing process). The solid phase of

the pressed product is called pressed & dewatered EFB (with moisture content of about 50%). The liquid phase of the pressed product is called pressed EFB liquor.

SOLID PHASE: PRESSED AND DEWATERED EFB

1. As mulching material in the oil palm estate

EFB will degrade fully in about 6 months. The degradable pressed and dewatered EFB can partially rehabilitate and recuperate the nutrients in the soil. However, it requires a lot of effort and energy as well as added costs as it is very labour intensive to transport and distribute in the estate.

2. As composting material to produce organic fertiliser

The pressed and dewatered EFB is mixed with palm oil mill effluent (POME), composted, bio-reacted and degraded to produce an organic fertiliser which is suitable for rubber and oil palm plantations, vegetable farms and plant nurseries.

3. Alternative fuel for palm oil mill solid fuel boiler

In addition to getting pressed liquor and to recover oil, the pressed and dewatered EFB bunch from the EFB press can also be utilised as short and loose fibre. This shredded EFB fibre, mainly ½" to 2" in length, with a maximum moisture content of 40%, is a good combustible fuel for solid fuel steam boilers in palm oil mill as well as other industries. Furthermore, this also means a lower consumption of palm kernel shell and mesocarp fibre (the fibre from the oil palm fruitlets skin) as fuel for steam boilers. The palm kernel shell saved can be sold to other industries such as the glove, latex and bricks factories. This will generate extra revenue for the company. Currently the price of the raw palm kernel shell (ex-mill) is RM150 to RM170 per metric ton.

4. To produce dried long fibre (DLF): Highest value-added products

Pressed EFB bunch can be used to produce dried long fibre as a raw material for fibre-based end products such as mattresses and cushions which traditionally use coconut fibre. The DLF produced is biodegradable, healthy and environmental friendly. It contains no toxic elements. With this the pressed and dewatered EFB can be used to produce higher value-added products and generate even more revenue for the company besides solving the Department of Environment (DOE) issues on EFB liquor (water pollutant-based liquor). Not only that but it can also solve another potential DOE issue, that of EFB disposal. This is linkable to the government enforcement programme which strictly controls the application of burning EFB in the incinerator, especially in Sarawak. It was prohibited in all other States a few years ago.

LIQUID PHASE: PRESSED EFB LIQUOR

THE VITAL APPLICATION OF THE HEAVY PHASE OF THE PRESSED EFB LIQUOR

- **Heavy phase as High COD (Chemical Oxygen Demand) agent for enhancing methane gas formation**

Chemical Oxygen Demand (COD), in layman's terms, is the standard method for indirect measurement of the amount of pollution (which cannot be oxidised biologically) in a sample of water. The COD test procedure is based on the chemical decomposition of organic and inorganic contaminants, dissolved or suspended in water. The result of a COD test indicates the amount of

water-dissolved oxygen (expressed as parts per million or milligrams per litre of water) consumed by contaminants during two hours of decomposition from a solution of boiling potassium dichromate. The higher the COD, the higher the amount of pollution in the test sample. For contaminants that can be oxidised biologically, the biological oxygen demand (BOD) method is used.

▪ **In line with Biogas Capturing Project (MPOB and DOE requirement) – Higher COD obtained**

Besides the free oil recovery, the EFB press machine serves to remove excess water in the EFB (moisture reduction) to suit its various applications as well as requirements from the relevant government authorities.

BIOGAS CAPTURE AND CDM PROJECT IMPLEMENTATION FOR PALM OIL MILLS IN MALAYSIA

Under the National Key Economic Areas (NKEA) plan by the Government in the 10th Malaysia Plan (2011-2015), efforts have been put in to transform the country from a middle-income to a high-income nation.

The importance of biogas trapping is evident from its inclusion as one of the eight Entry Point Projects (EPPs) of the palm oil sector under NKEA.

In this context, the Malaysia Palm Oil Board (MPOB) and the DOE have set up regulations towards this implementation. The basic requirements on biogas capturing can be summarised as follows:

1. MPOB Licence condition for all the palm oil mills (compulsory)
2. For existing mills to have biogas capturing by 1 January, 2017, or the latest by 1 January, 2020.
3. Compulsory criteria and condition for upgrading or extension of existing palm oil mills or construction of new mills, effective 1 January 2014.

VITAL ROLE OF PRESSED EFB LIQUOR IN BIOGAS CAPTURING PROJECT

The pressed liquor after EFB bunch press will be collected and pumped to a vertical oil recovery tank. The heavy phase of the clarifier tank will be pumped to the effluent treatment plant together with waste water from condensate pit and oil room sludge pit.

Conventionally, the COD of raw palm oil mill effluent without EFB pressed liquor, will be in the range of 45,000mg/L (milligram per litre) to 55,000mg/L. By having the EFB pressed liquor, the COD concentration can be as high as 75,000mg/L to 90,000mg/L.

The higher value of COD will definitely help generate significantly more biogas (methane gas). With more biogas formation and captured, useful applications or utilisations can be implemented more cost effectively besides fulfilling the requirements set by the authorities. ■