

PRODUCTION OF POWDERED PALM KERNEL SHELL USING A NANOMASS PLANT

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The production of crude palm oil (CPO) in the mill generates a huge amount of biomass such as palm kernel shells (PKS), press fibres and empty fruit bunches (EFB). Press fibres are widely used as fuel in the mill boiler together with small quantities of PKS. With the current scenario where biogas from palm oil mill effluent (POME) is captured, and the use of the biogas for co-firing in the boiler is gaining popularity, the excess of these biomass by-products will be much more. In order for better and more effective utilisation, the conversion of this biomass into a more suitable form such as powder is very important. Commercial production of biomass powder at low cost is one of the approaches to enhance and create more new products and applications of oil palm biomass. There are several conventional pulverisation techniques such as cutting, drying, hammer milling, grinding and sieving. However, those methods are not economically viable for mass production of biomass powder into micron size due to their energy intensity and high wear and tear of the machinery. This new system called Nanomass Technology System (NTS) has been developed and tested to convert the biomass, particularly PKS into powder form using a single machine (Figure 1a). Since the product is in a dry powder form, it is easier and cheaper in terms of handling, transportation and storage. The product can be used as a feedstock for other industries such as the production of biomass pellets, bio-plastics, 2nd generation biofuels, etc. The powder has higher surface area and thus the reaction is much faster and more efficient compared to the original size.

WORKING PRINCIPLE OF THE SYSTEM

The novelty of the system is the application of ultrasonic technology to disintegrate oil palm biomass into small particles and fine powder (Figure 1b). The working principle of the NTS is the creation of a standing wave using high speed rotation of the rotor in the system which will create an ultrasonic sound wave which resonates within the implosion chamber. The material that enters the

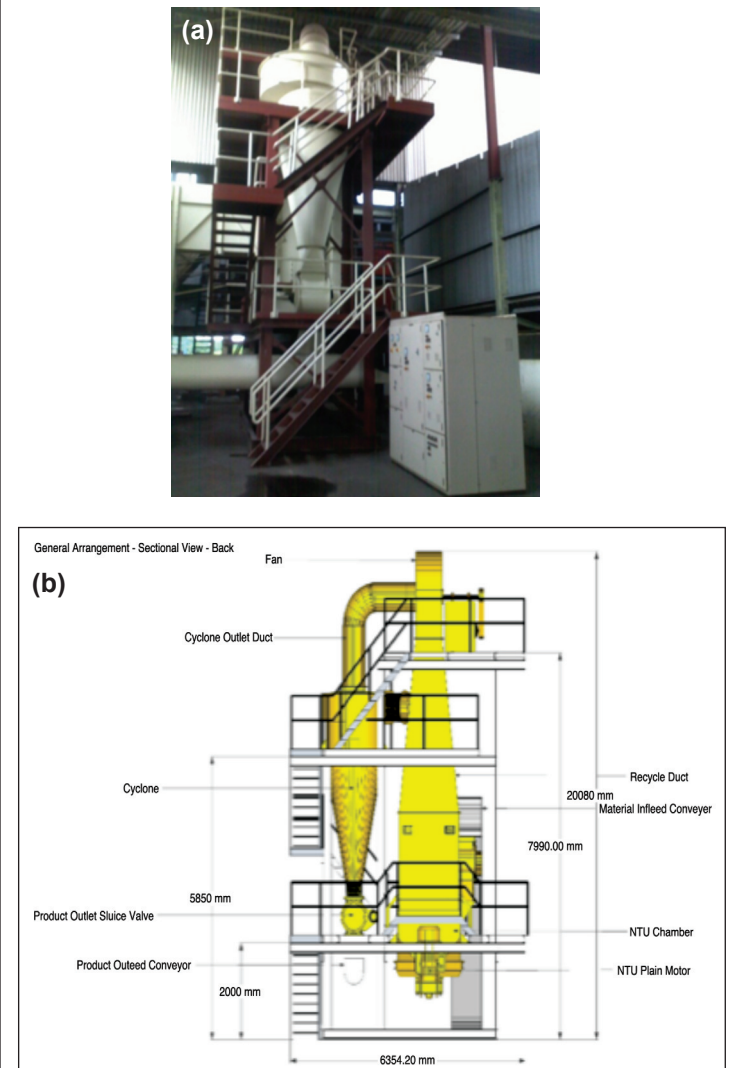


Figure 1. (a) Nanomass Technology System installed in POMTEC, Labu, Negeri Sembilan; and (b) schematic diagram of the Nanomass Technology System.

chamber is subjected to the standing wave which resonates causing the molecular structures of the material as well as the moisture particles within, to oscillate at high frequency, causing the moisture bubbles to expand until the point where implosion occurs and the material disintegrates and become fine powder whilst the moisture turns into water vapour. The product obtained is in a dry powdered form. By varying the speed of the rotor system, the ultrasonic sound pattern and frequency



will change accordingly and specifically disintegrate the materials of different characteristics such as palm shell, EFB, palm frond and chips of palm trunk into fine particles (Figure 2a).

POWDER SIZE DISTRIBUTION

Almost 94% of the PKS powder obtained has a size in the range of 90 to 500 microns (Figure 2b), and with moisture content in the range of 7% to 10%. This is based on machine speed of 1100 rpm without air classifier. Nevertheless, better and more uniform sizes of powder would be able to be produced with the installation of an air classifier. At higher speed, it is expected that a much drier powder at more uniform sizes will be produced.

APPLICATION OF PKS POWDER

By turning the oil palm biomass into fine particles/powder, it will open up new applications for many high value-added products. It also enhances the product properties due to increase of surface reactivity and ease the handling, transportation and reduction in storage cost. In the application as boiler fuel, the combustion of these fine particles will enhance combustion and reduce particulate emission. When used as feedstock for 2nd generation bio-fuels (e.g. bio-oil, bio-ethanol) and bio-fertiliser, the reaction with the chemicals or effective microbes will be much more effective and faster due to the high surface area. The powdered biomass can also be used as filler for the production of bio-degradable plastic, bio-composite, bio-resin, etc.

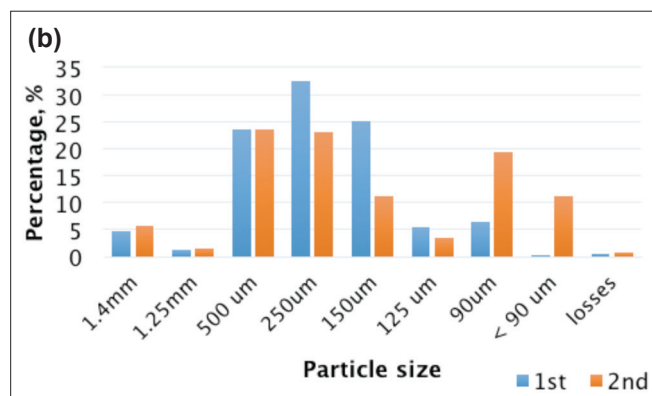


Figure 2. (a) The powdered PKS produced from the Nanomass System, and (b) the size distribution analysis of the powdered PKS.

ECONOMIC ANALYSIS

1. Assumption

- a) Plant running at 16 hr per day and 300 days per year
 - b) Price of raw material, PKS; RM 170 t⁻¹ (mc 20%)
 - c) Price of PKS powder; RM 450 t⁻¹ (depending on size and mc)
 - d) Yield: 90% (due to mc): Product; 2.25 t hr⁻¹ (mc 10%)
- * mc – moisture content

2. Investment cost

Nanomass Technology System Plant (capacity at 2.5 t hr ⁻¹)	RM 1.30 million
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3. Operating cost (per year)

- | | |
|--|--------------|
| a) Part replacement and maintenance cost | RM 120 000 |
| b) Manpower requirement = 3 process workers x 2 shifts x
RM 1200/month x 12 months | RM 86 400 |
| c) Utility, power requirement = 190 kWhr x RM 0.35/kWhr x
16 hr/day x 300 days/year | RM 319 200 |
| d) Raw material cost = RM 170 x 2.5 t hr ⁻¹ x 16 hr/day x
300 days/year | RM 2 040 000 |

4. Direct gain / profit (per year)

- | | |
|--|--------------|
| a) Revenue from sales; RM 450 x 2.25 t hr ⁻¹ x
16 hr per day x 300 days/year | RM 4 860 000 |
| b) Profit: RM 4 860 000 – (RM 120 000 + RM 86 400 +
RM 319 200 + RM 2 040 000) | RM 2 294 400 |

Payback period ~ 6.3 month = 7 months

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