HIGH POROSITY CARBON POWDER FROM OIL PALM EMPTY FRUIT BUNCHES FOR ADSORBENT PRODUCTS

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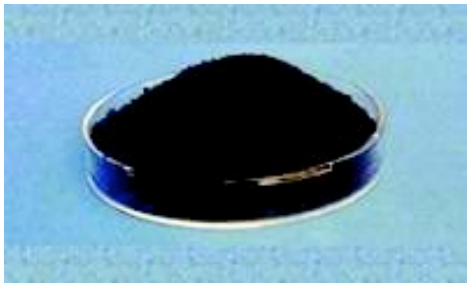
Production of advanced carbon products from oil palm empty fruit bunches (EFB) has been investigated since 2003 (Astimar *et al.*, 2003). Recently, MPOB has developed a process to prepare high porosity carbon and molecular sieve carbon (MSC) for gas filtration from EFB (Astimar *et al.*, 2005a, b) (*Figure 1).*



Density = 0.95 - 1.30 g cm^{-3}
Pore surface area (S_{BET}) = 680 - 1123 cm^2 g^{-1}
Micropore surface area (S_{MICRO}) = 360 - 1016 cm^2 g^{-1}

Figure 1. High porosity activated carbon powder from EFB.

EFB contains about 77.7% holocellulose, made up of 44.2% α-cellulose, 33.5% hemicellulose and 20.4% lignin (Basiron and Husin, 1996). These components contribute to the carbon content of the EFB of 42%-43% (wet basis) (Gurmit *et al.*, 1990).

Porous carbon powder from EFB has to compete with carbon from petroleum extract and coal. With the recent rises in coal and petroleum prices, it is expected that the carbon powder from EFB can be competitive, besides offering other advantages:

- replacing raw materials from non-renewable sources (petroleum/coal extracts) with materials renewable materials (agricultural by-products);
- supports the policy of zero waste in the oil palm industry and adding value to the oil palm EFB; and
- encouraging the utilization of renewable sources available as agricultural by-products for value-added products

PREPARATION OF CARBON POWDER

High porosity carbon powder is prepared from carbon pre-cursors - intermediate raw materials from low temperature pre-carbonization of EFB chips. The process reduces almost 40% of the EFB weight by partially pyrolysed out minor components, such as extractives and hemicellulose, hence, reducing the chemicals required for activation. Chemical treatment, carbonization and physical activation processes are applied to the carbon pre-cursors to turn them into high porosity carbon powder (*Figure 2*).

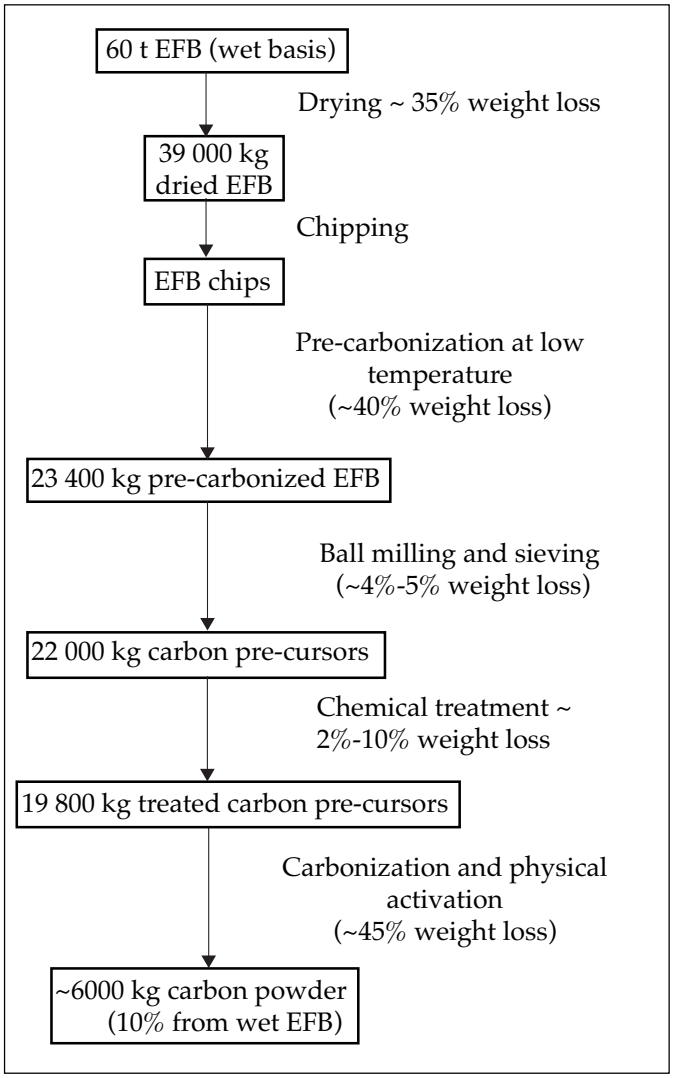


Figure 2. Flow chart of the preparation of carbon adsorbent from EFB.

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ECONOMIC VIABILITY STUDY

The costs are estimated for processing 60 t EFB (wet) assuming a 10% yield over 320 days per year (*Table 1*). The annual production cost was estimated at RM 10.5 million for an output of 1 920 000 kg. Therefore, the estimated cost is RM 5.47 per kg. With the high porosity and high density of the carbon powder, it can be sold in niche markets for examples, carbon molecular sieves, carbon electrodes and for metal ion-adsorbing carbons. Such carbon powders are sold for about RM 50 to RM 80 per kg.

TABLE 1. SUMMARY OF ESTIMATED COSTS OF PROPOSED POROUS CARBON POWDER PRODUCTION

Measurement	Value
EFB (wet)	60 t
Equipment purchase	RM 5 600 000
Capital cost	RM 24 000 000
Total fixed capital investment	RM 29 600 000
Total annual operating cost	RM 10 500 000
Estimated annual production of carbon	1 920 000 kg
Estimated cost of carbon	RM 5.47

REFERENCES

ASTIMAR, A A; MOHAMAD, M; RUS MAHAYUNI, A R; RAMLI, O; MOHD HAFIZUDDIN, J; MAZLIZA, M and MASLIANA, M (2003). Analysis of porosity in carbon from alkaline (KOH) treated self-adhesive carbon grains from oil palm bunch. *Solid State Science and Technology Vol. 11(1)*: 1-8.

ASTIMAR A A; MOHAMAD, D; MOHD HAFIZUDDIN, J; RAMLI, O; ABUBAKER-ELSHIEKH, A; PENG, T H; MOHTAR, M; MUSLIMIN, M; LING, Y Y and MEIHUA, J T (2005a). Mesopores and micropores of carbon pellet prepared from H_2SO_4 treated self-adhesive carbon grains from oil palm empty fruit bunches. *J. Solid State Science & Technology, 13(1 & 2)*: 134-142.

ASTIMAR, A A; MOHAMAD, D; MOHD HAFIZUDDIN, J; OMAR, R; ABUBAKER-ELSHIEKH, A; PENG, T H; MOHTAR, M; MUSLIMIN, M; LING, Y Y and MEIHUA, J T (2005b). O_2 and N_2 separation of carbon pellet prepared from CO_2 activation of activated carbon from empty fruit bunch. *J. Solid State Science & Technology Letters, 12 (1)*: 98.

BASIRON, Y and HUSIN, M (1996). Availability, extraction and economics of oil palm biomass utilization. *Proc. of the 4th Oil Palm Tree Utilization Committee Seminar - Progress Towards Commercialization.* p. 3-15.

GURMIT, S; MANOHARAN, S and TOH, T S (1990). United Plantations approach to palm oil mill by-product management and utilization. *Proc. of the 1989 International Palm Oil Development Conference* (Jalani, B S *et al*., eds.). PORIM, Bangi. p. 225-234.

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