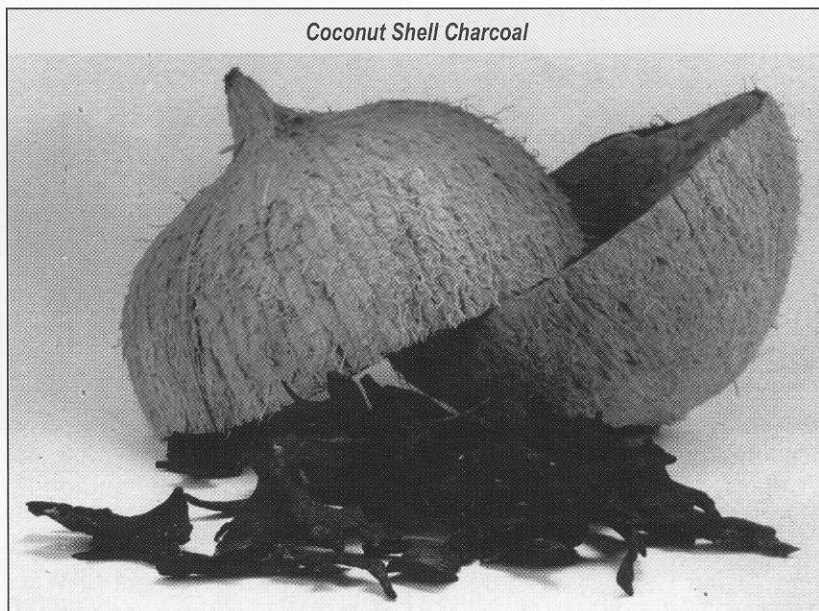


## VARIOUS USES OF COCONUT SHELL

*Yanni Sudyani*

In these days of energy shortage, the worth of the coconut as a renewable energy source deserves consideration. The coconut oil is the item first remembered as the energy-rich component. Several studies have been made in the past regarding energy from coconut oil. But if entire dependence is made on the oil (as for diesel fuel substitute), the yield is rather low, being only 10% of the weight of the nut; the soybean is a better performer, at 18% oil. The coconut however is unique in having other components of the nut that are potentially large energy sources. These are the husk, the shell and the leaf. The energy potential of the components of the coconut is given in Table 1.



extremely high. As one would expect they have a very high energy density. A coconut shell

concentrated form of energy; thus while coconut shell has a heating value of 5,500 kcal/kg, the charcoal made from it has a heating value of 7,200 kcal/kg.

**Table 1. Energy from Components of an Average Coconut**

| Component                  | Kg  | Kcal/kg | Energy Kcal | Percent of Total Energy |
|----------------------------|-----|---------|-------------|-------------------------|
| Coconut Oil                | .12 | 9000    | 1080        | 27.7                    |
| Carbohydrates and proteins | .06 | 4000    | 225         | 5.7                     |
| Shell                      | .18 | 5500    | 990         | 25.4                    |
| Husk                       | .40 | 4000    | 1600        | 41.1                    |
| Total                      | .76 |         | 3895        | 99.9                    |

The carbonization of coconut shell obtained a yield of 32.5% charcoal. The non-condensable gases, which may be used as gaseous fuel, amounted to 16.2% of the weight of the shell; as diagrammed in Figure 1.

Carbonization of the shell in a retort at 315 °C gave a charcoal with a heating value of 7,860 kcal/kg and fixed carbon of 83.9% while kiln produced charcoal at 324 °C gave fixed carbon of 69.5% and kcal/kg of 6,784.

### Activated carbon

Coconut shell charcoal finds wide use as a fuel and as a base material for the manufacture of activated carbon. Activated charcoal (charcoal activated with CO<sub>2</sub>, water vapor, or chemical compounds) made of coconut shell has advantages compared to other materials (wood,

The energy value of coconut oil is taken at 9,000 kcal/kg and was adopted after considering the value of 9,288 kcal/kg, gross. Since kcal/kg increases with molecular weight, the rounded figure of 9,000 kcal/kg may be taken as the "best value". The calorific value of coconut shell is 5,500 kcal/kg.

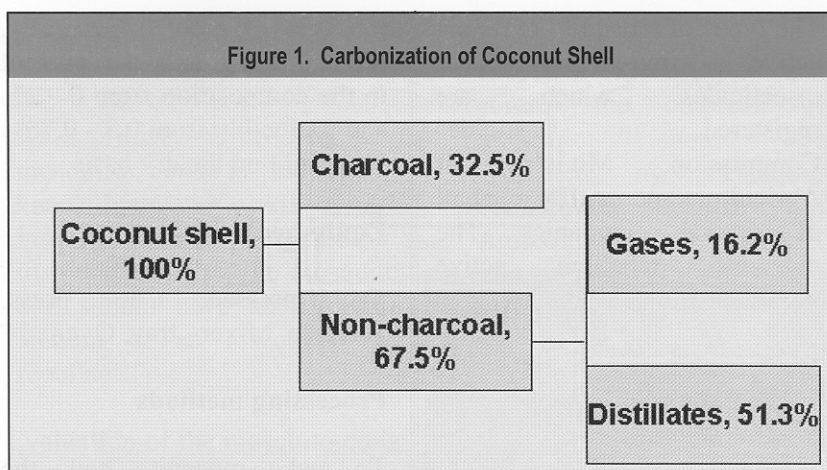
### Coconut shell charcoal

Coconut shell has specific gravity of 1.1, which is

can be burned directly as fuel, though it tends to burn extremely hot, which may not make it ideal for cooking. However, it can be easily processed into charcoal and combustible gases. Whereas 10 kg of wood makes only one kg of charcoal, 10 kg coconut shell produced 3 kg charcoal and 5.5 kg of combustible gases.

Charcoal has desirable characteristics as a fuel. It is non-smoky when burned and is not subject to organic decay, and is a

Figure 1. Carbonization of Coconut Shell



rice husk, corn cob) because of its ability to absorb color or aroma. It is used as supporting material for food and non-food industries (processing of cooking oil, sugar, and chemical matter purification).

More over much attention has been paid recently to the use of charcoal made from coconut shell by thermal conversion as a source of carbon materials. It is being used as a new carbon material on recent developments in carbon material science. Fire-resistive materials or electro-magnetic shielding materials were developed from coconut shell charcoal with excellent performances as those of metallic materials. They can be used as environmental purification materials or humidity control materials.

### Processing of Activated Charcoal

Materials and Equipment for processing of Activated Charcoal are: Coconut shell; Drum or burning sink; Oven; Plastic pail; Crusher wood/iron; Draining tray; Distilled water; and Sieve, 100 mesh.

### Methods

1. Separate and clean coconut shell from other materials, such as coconut fiber or soil.
2. Sun dry.
3. Burn dried coconut shell at burning sink or drum at 300 - 500°C for 3 - 5 hours.
4. Soak charcoal in chemical solution (CaCl<sub>2</sub> or ZnCl<sub>2</sub> 25%)

for 12 - 18 hours to become activated charcoal.

5. Wash charcoal with distilled/clean water.
6. Spread on tray at room temperature to be drained.
7. Dry in oven at temperature 110°C for 3 hours.
8. Crush or refine activated charcoal with crusher wood/iron into size of 100 mesh.
9. Pack activated charcoal in plastic bag.

### Mosquito coil

While the coconut shell may be used for fuel, to explore how well coconut shell can be

used, it seems likely that they can be converted into more value-added alternative products. Because of its inherent characteristics of withstanding at high temperature, low burning and being floppy, it is widely used for the manufacture of insect repellent in the form of mosquito coil.

Mosquito coil is widely known as an efficient mosquito repellent. Burning mosquito coils indoors generates smoke that can control mosquitoes effectively. This practice is currently used in numerous households in Asia, Africa, and South America.

Recently, dengue fever symptom in Indonesia becomes serious problem. In 2007, Indonesia was on course for some 200,000 dengue fever infections, twice last year's total. To anticipate it, the Government of Indonesia has declared the triple-Programs (Drain, Bury, and Close standing water). The use of

Activated Carbon/ Coconut Shell Charcoal



mosquito repellent such as mosquito coils is one of the preventive efforts to anticipate dengue fever outbreak. Mosquito coils can be an effective mosquito repellent since it is cheap and effective for reducing mosquito bites, yet it has several weaknesses such as unintended hazards to respiratory health resulted from the smoke of coil combustion. However, the health impact of mosquito coils could be reduced by switching to a less-polluting formulation using raw material which emitted less particulate matter.

### Type of mosquito repellent

There are many various mosquito repellent in the market, from the simplest to the high technology form. In Indonesia, an estimated seven billion coils are purchased annually. Beneath it all, the main purposes of mosquito repellents is to prevent and control the outbreak of mosquito by reducing mosquito bites and the diseases they carry. Common mosquito repellents in the market including:

1. Electric mat
2. Lotion
3. Aerosol or spray
4. Mosquito coil
5. Ultra sonic

In spite of the advance technology of mosquito repellents manufacture, mosquito coil still be preferred particularly in rural community.

### Type of mosquito repellent active ingredients

The types of mosquito repellent active ingredients are insecticides which are registered in Pesticides Commission, Ministry of Agriculture and usually a patent of several companies. The mosquito repellent active ingredients including:

1. Bifenthrin
2. Cyfluthrin
3. D-Allethrin
4. Dichlorophenyl dimethylphosphine
5. Propoxur
6. Transfluthrin

### Important factors for the manufacture of mosquito repellent

1. Safety: do not contain unintended hazards substances.
2. Effectivity: effective to prevent and control the outbreak of mosquito by reducing mosquito bites.
3. Price: achievable especially by poor communities.

### Mosquito coil composition and Processing methods

#### Materials composition:

50% of sawdust having a particle size around 70 mesh, 30% of coconut shell flour, 20% of starch wood powder as a binding agent, 125% of water by weight based on dry ingredients. Other ingredients may be incorporated into the mosquito coil, such as dyes, pigments, etc., to improve the aesthetic properties.

Traditional and conventional burning aids can be utilized, such as sodium and potassium nitrate, sodium benzoate, and

mixtures thereof. Generally, these burning aids are present in the composition from 0 - 2% and preferably from 0.3 - 0.75% by weight on the dry basis.

### Equipment

Coil pressed, Cool press, Balance, Mixer, tray, Oven.

### Processing methods

To make mosquito coil, the coconut shell were powdered crushed in crusher machine to small size 80 mesh. Weight all of materials and adding 125% water by weight on a dry basis of a raw material, mixed well 20-30 minutes, for sufficient time to properly turned to the paste, the paste rolling or pressing a sheet of coiled dough to a uniform thickness  $\pm 4$  mm and stamped into coils. After the mosquito coil are formed as planar circular, hexagonal or other shaped, then dried in oven 50°C until moisture content 8%.

At the terminal end of each coil, approximately in the centre, is a small aperture which is used to locate the mosquito coil on an upstanding pin, which forms part of a stand for the coil. This stand may also form part of a dish or tray which is used to collect the ashes of the combusted coil. Once located on the stand, the coil forms a continuous spiral with the beginning of the coil, which is where combustion commences, at a point exterior to the terminal end, which sits on the locating pin. In this way the continuous spiral forms a track which combusts from the outer beginning end to the mounted terminal end.

## Evaluation of mosquito coils product

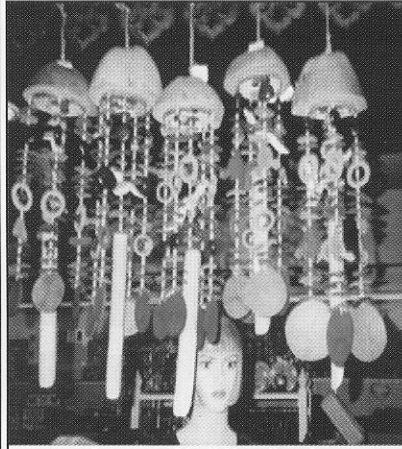
As a primary purpose of the mosquito coils is to repel, knock down and/ or kill flying insects which may be present in living quarters, the mosquito coil should have an effective amount of an insecticide or repellent.

Evaluation of the mosquito coils product (In Indonesia) comprises:

- Performance of the product: not brittle, strengthened the surface and smooth
- Good burning properties: mosquito coil should be burning continuously for 7

hours.

- Effective to prevent and control the outbreak of mosquito: should be evaluated by Pesticides commission, Ministry of Agriculture



Coconut Shell Handicrafts

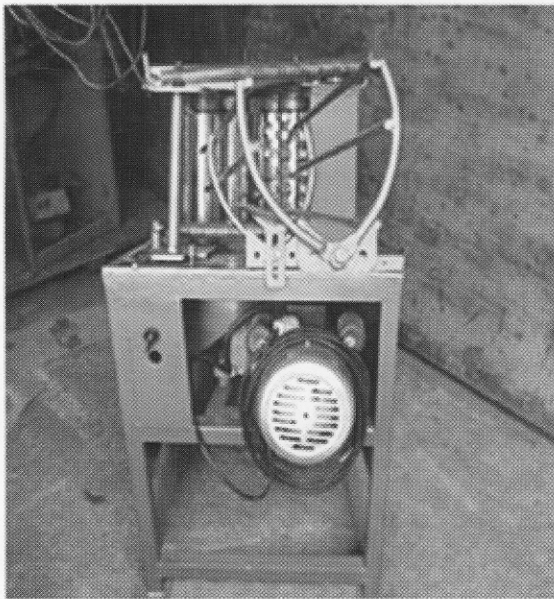
## Miscellaneous products

Other miscellaneous products can be made from coconut shell for decorative and accessories are Tiles for interior, table ornaments, Handicraft, sculpture, star bird holekamoly, belt, handbag, necklace, snacks dish, clothing label, GAC Cartridge, curios, and others.

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*The article is through the courtesy of Research Center for Chemistry, Indonesian Institute of Sciences.*

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