DENR Recommends

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PRODUCTION OF DENR CHARCOAL BRIQUETTES FROM FOREST WASTES

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PRODUCTION OF DENR CHARCOAL BRIQUETTES FROM FOREST WASTES*

The DENR charcoal is a solid fuel that is produced using leaves, twigs, stems and other cellulosic forest wastes. These are compacted into briquettes. When burned, the DENR charcoal emits a steady heat with low clean flame. It is easy to ignite and burns completely in a t least 50 minutes.

The use of charcoal briquettes can reduce wood charcoal consumption of poultry farms, households and domestic enterprises which is about 590 t/year or an equivalent of 26,970 m^3 fuelwood. Shifting to DENR charcoal not only puts forest wastes into good use but also helps mitigate carbon dioxide emission in the atmosphere and lessens the depletion of the country's forest resources.

Objectives

This project has been implemented with the following objectives:

- To reduce pressure in cutting/using wood from the natural forest, which is traditionally used for charcoal production in the uplands;
- To provide additional source of income and livelihood opportunities to the upland farmers;
- To produce charcoal briquettes from raw materials such as leaves, twigs, grasses and other woody items and forest wastes;
- To enhance resource recovery from forest wastes;
- To provide a cheap source of fuel fro domestic and industrial uses; and
- To produce a biofuel that is environment-friendly, economically feasible and socially acceptable.

This is a joint project of the Ecosystems Research and Development Bureau (ERDB) and the Forest Products Research and Development Institute (FPRDI)

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* Manuscript and materials were prepared by Santiago R. Baconguis, Alicia G. Calderon and Juliana B. Zuñiga assisted by other members of the task force.

PROCEDURE

1. Preparing the raw materials.

Collect the wood (e.g., gmelina twigs, ipil-ipil branches) and nobiomass materials (e.g., coconut leaves) that are traditionally considered as wastes. Sort these raw materials. Chop the large-sized raw materials and then, dry them. Reduce large pieces into finer ones by grinding. Screen the ground materials using a 40-mesh metal strainer.

a. *Pruned branches and twigs are good sources of raw materials for charcoal briquette production.*
b. *Sorting of raw materials like coconut leaves, gmelina twigs, ipil-ipil branches.*
c. *Chopping of raw materials.*
d. *Drying of raw materials such as peanut shells, rice hull, gmelina twigs/brances and leaves.*

2. Carbonizing.

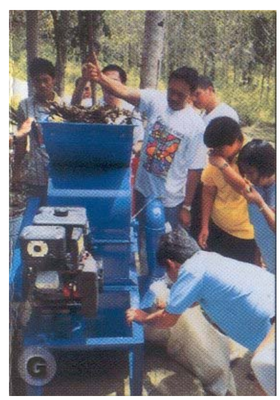
This can be done either by the drum method or by the metal plate method designed by the Forest Products Research and Development Institute (FPRDI). Use the drum method in carbonizing larger materials like twigs and corncobs. For pulverized materials, use the metal plate method.

e. Modified drum kiln can be used for charring shells, husks, wood pieces and corncobs.

3. Shredding/Grinding.

The common practice is that raw materials are carbonized first, using the drum method, or the metal plate method before they are fed to the grinding machine. These are placed inside the hopper to produce fine carbonized materials.

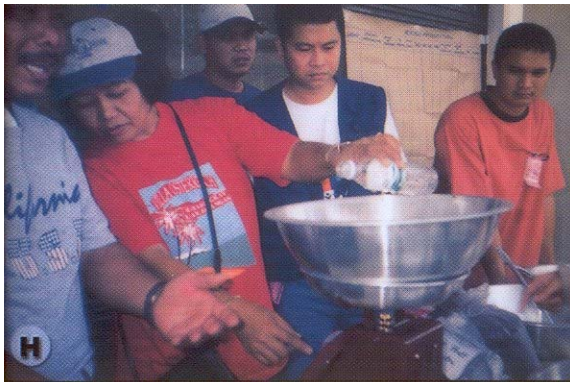
If the materials are raw (twigs, branches, corncobs) the shredding machine is used. If the materials are carbonized, the grinding mechanism is used. However, if the materials are too wet, they can be used for composting.



f. The metal plate carbonizer is a simple low-cost machine capable of carbonizing not only sawdust and rice hull but also coconut coir dust and other carbonaceous fine materials.
g. Participants demonstrate the use of a shredding machine for grinding bigger-sized raw materials.

4. Preparing the binder.

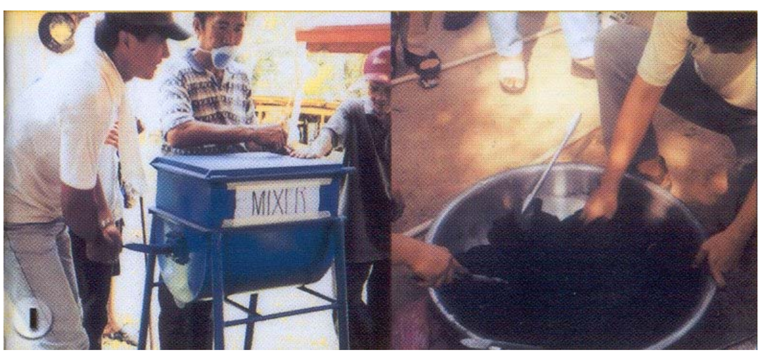
The FPRDI recommends cassava flour as binder because it is available in local markets. The amount of starch to be used for carbonized charcoal briquettes is 6% to 25% of the total weight of the raw materials. This means that every 1 kg of ground materials needs 150 g of cassava flour. The amount of water needed to gelatinize the starch ranges from 60% to 100% of the weight of the raw materials.



h. Cassava flour is the recommended binder for the DENR charcoal.

5. Mixing.

This is the process of coating every particle of ground materials with a film of binder. It will enhance adhesion and produce uniform good quality briquettes. Pour proper proportions of ground materials and gelatinized starch into the mixing container. Mix the ground materials and the binder thoroughly.



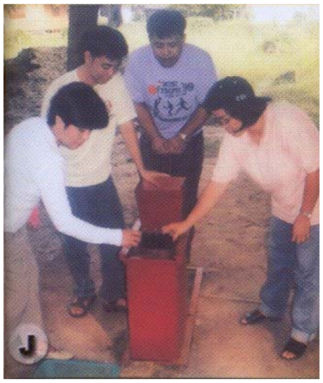
i. The fine carbonized materials and the binder are mixed manually.

6. Briquetting.

The mixture is converted into finished products using the manual briquettor. Pour the mixture directly into the molder which produces it into uniform-sized briquettes.

7. Drying.

Place the briquettes in trays. Dry them under the sun for two days during sunny days or use a suitable drier during rainy days.



j. Briquetting machine is a simple energy- and money-saving device made out of locally-available materials. It is used for converting charcoal fine into charcoal briquettes.

k. The briquettes are place in trays and dried under the sun for two days during sunny days, or placed in a suitable drier during rainy days.

8. Packaging.

Pack the dried briquette in plastic bags and seal them. Charcoal briquettes are ready for use.

l. These charcoal briquettes are produced in a manually-operated briquetting machine.

HEATING VALUES OF SELECTED SPECIES

At present, there are several species and species combinations which ERDB researchers have tested in the laboratory of FPRDI. The heating values are shown in Table 1.

Table 1. Heating values of various sample briquettes.

Sample Materials	BTU/lb (carbonized)
Coconut husk	11,934.12
Rice hull with 8% nami as binder	5,714.70
Sawdust with 8% nami as binder	10,297.67
Coconut shell	11,180.93
Peanut shell	10,997.89
Corncob	13,297.91

Source: FPRDI (1996)

Table 2. Heating values of charcoal briquettes from a CBFM pilot site in Sta. Catalina, Atimonan, Quezon and ERDB Los Baños Experiment Station, Mt. Makiling, Los Baños, Laguna.

Species and Species Combination	BTU/lb (carbonized)
Gmelina (sawdust), narra twigs, mixed kakawate (twigs and leaves) with 18% binder	8,627
Gmelina leaves, tibig and avocado leaves, ipil-ipil twigs (20%) with 18% binder	9,234
Cocoshell, coffee, and mahogany leaves, cogon, gmelina, flemingia leaves with 18% binder	9,954
50% coconut shell 50% gmelina leaves with 18% binder	10,103
50% ipil-ipil twigs 50% gmelina leaves with 15% binder	8,897
Upling gubat (leaves and twigs) with 16% binder	9,342
50% coffee twigs and balinghasai twigs 50% coffee leaves and gmelina leaves with 15% binder	9,048
50% coffee twigs 50% coffee leaves with 15% binder	9,224

Source: ERDB (1999)

Table 3. Proximate charcoal analysis of selected species combination from Marcher Wood Industries Corporation in Diffun, Quirino.

Species Combination	Proximate Chemical Analysis				
	Ash (% A)	Fixed Carbon (% FC)	Sulfur (% S)	Calorific Value (CV-cal/g)	BTU/lb
Marcher wood fines + Corncob fines	10.60	44.32	0.42	6,134	11,041
Gmelina wood fines + Corncob fines	7.32	62.56	0.05	5,159	9,286
Common hardwood fines	8.18	59.34	0.07	5,920	10,656
100% ipil-ipil twigs/branches	3.70	64.93	0.06	6,394	11,510

Source: ERDB (2001)

Status

ERDB has produced under laboratory condition, charcoal briquettes from different species and has piloted the technology in the CBFM areas. Trainings in different regions were conducted as part of the DENR's thrust in bringing the technology to the uplands as one of their livelihood projects. DENR charcoal briquettes made from several species and species combination were already tested with regard to their heating value. For each region, locally-available materials were used. At present, about 30 species of wood and nonwood biomass can be used as raw material.

Table 4 shows the financial parameters and the results of the preliminary computation for 5 years using assumptions from the average data of the six sites where training took place. It reveals that using 10%, 12% and 15% interest rates, the Net Present Value (NPV) was computed at P162,464; P149,802; and P132,812. The Internal Rate of Return (IRR), on the other hand, was 92% with an earning capacity of 1.16, 1.15 and 1.14, respectively. Such results indicate that the project is feasible and can be considered by upland communities as one of their income-generating activities.

Table 4. Preliminary results of financial analysis using averages from the six regions.

Parameter	Interest Rate		
	10%	12%	15%
Net Present Value	P162,464	P149,802	P132,812
Cost-Benefit Ratio	1.16	1.15	1.14

Internal Rate of Return: 92%

FACTS ABOUT FUELWOOD AND CHARCOAL IN THE PHILIPPINES

- Fuelwood/charcoal consumption in the Philippines in 1989.

- 24,67t (World Resources, 1992-1993)
- 29,15t (World Bank, 1992. *The Philippine Household Energy Strategy Study*, A Joint UNDP/World Bank Energy Sector Management Program, 1992)

(*Source*: RWEDP. 1996. Woodfuel Flows. Bangkok, FAO-Regional Wood Energy Development Programme, Report No. 30. p. 2)

- Estimated fuelwood/charcoal supply and demand based on the DENR Master Plan for Forestry Development in 1990.

Supply	Demand	Shortage
23.2 m^3 or 17.4 t	38.7 m^3 or 29.0 t	15.5 m^3 or 11.5 t

- Comparative analysis of type of charcoal required per household.

Charcoal	Fuelwood required Per household (1 day = 3 meals)
• Ordinary charcoal	3.50 kg
• DENR noncarbonized charcoal	2.01 kg
• DENR carbonized charcoal	1.69 kg

PROCESS FLOW IN THE PRODUCTION OF DENR CHARCOAL BRIQUETTES