Analysis of Charcoal Briquettes Produced from Agro Wastes

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ABSTRACT

This paper deals with agricultural waste management by preparing charcoal by slow pyrolysis/carbonization from agricultural wastes. The waste agro products after carbonization process are uneven size and not suitable for briquetting. So, after pulverization binder is added to it. Then the charcoal briquettes are dried to remove moisture. Calorific value of the briquettes is determined. Proximate and ultimate analyses of the charcoal briquettes are carried out to determine various parameters. It is recommended to adapt the method explained to find solution for agricultural waste disposal and effective utilization of them to solve the problem of fuel scarcity.

1. INTRODUCTION

Agriculture is the most widely practiced occupation in the world, and there is a wide diversity of activities connected with it. Agricultural production leaves considerable amounts of waste. Some of them are recycled into the agricultural production as fertilizer, while large amounts remain unused and in many instances pose a disposal problem. Uncontrolled burning in the fields is not only a hazardous disposal solution it is also wasting useful energy. With efficient collection systems, waste from agricultural production can be utilised as fuel for power and heat production. The palm oil industry, for instance, produces significant amounts of empty fruit bunch that can be incinerated. Liquid wastes may also be methanized and can secure a basis for own power and heat production. In the sugar industry, significant amounts of bagasse, the waste after extraction of sugar, is an equally excellent fuel. Rice production may also be industrialised to such an extent that rice husks are available in amounts sufficient for incineration in a boiler, thereby securing a basis for power and heat production. In the forest industry, large concentrations of biomass waste can be utilised for power and heat production, e.g. at sawmills. Nowadays, there are many agricultural residual wastes that can be turned into precursor for carbon production. Unwanted agricultural wastes, which are generated in huge amounts annually, can be converted into value-added materials. Many attempts were made to convert some agricultural waste into carbon. Raw materials for carbon are chosen depending on their purity, price, potential extent of heat production, and stability of supply. Agricultural waste was excluded from the regulations that controlled the management of household, commercial and industrial waste in India. This means that farmers have a duty to ensure that they do not treat, keep or dispose of agricultural waste in a manner likely to cause pollution of the environment or harm to human health. The environment, human health and agricultural practices are intrinsically linked environmental quality is crucially important to agricultural production and the management of agricultural waste. It is best to minimize waste at source and to organize recovery for re-use, wherever practicable. However, few studies have been conducted on the utilization of agricultural waste for composting and/or animal fodder, and none of them has been implemented in a sustainable form. In addition many farmers now view the practice of residue utilization as an extra cost with small returns, and that the best way in to get rid of the residues by dumping, open burning, etc. But the hazards to the environment of such practices can no longer be ignored.

The decreasing availability of fuel wood in most of the developing countries has necessitated the efforts be made towards efficient utilization of agricultural residues (Tripathi et al., 1998). Charcoal is the blackish residue consisting of impure carbon obtained by removing water and other volatile constituents from animal and vegetation substances. Charcoal is usually produced by slow pyrolysis, the heating of wood or other agricultural substances in the absence of oxygen environment at 450° - 510° C by using either in a kiln or a continuously-fed furnace called a retort. The resulting soft, brittle, lightweight, black, porous material resembles coal and is 85% to 98% carbon with the remainder consisting of volatile chemicals and ash (P.Sugumaran et al, 2010). Biochars were produced by pyrolysis of a variety of biological materials viz.,paddy straw, maize stover, coconut shell, groundnut shell, coir waste and prosopis wood. The Biochars differed much in their characteristics (Shenbagavalli et al., 2012).

The forest industry also supplies raw material for briquettes production, where sawdust, charcoal dust, degradable waste paper and dust from agricultural production may constitute a final utilisation of waste materials from agriculture related production. Twigs of prosopis, sesamum and pearl millet are considered for present study. The Processes include a number of stages, including collection of agro waste, carbonization, pulverizing, sieving, binding, briquetting, drying and sample analysis and it is given in the fig 1. Production of carbon from agricultural residual waste fulfill dual purpose of value addition by converting unwanted, surplus agricultural waste into useful fuel and solve the problem of waste disposal.

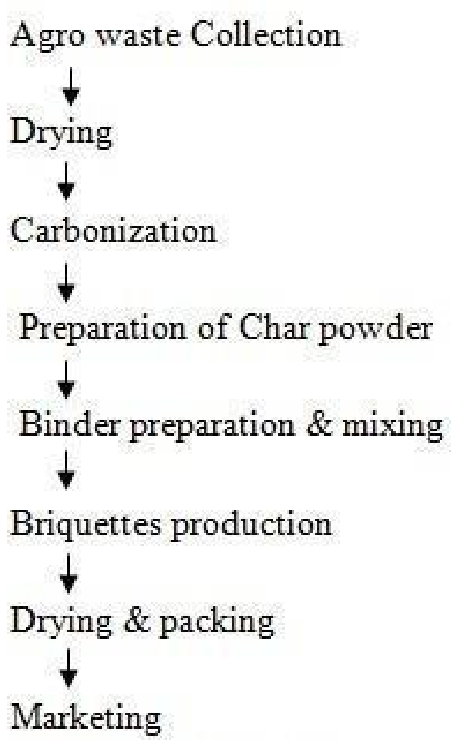

Fig 1: Briquetting from agricultural waste

2. PREPARATION OF CHARCOAL BRIQUETTES

The stems of sesamum and pearl millet are collected from the harvesting field. The prosopis is widely grown in many parts of TamilNadu, particularly in dry tract and waste lands. Twigs of prosopis are left in the field and causing serious problem because of sharp thorn and also venomous. It is available in large quantities. Agricultural and forest waste collected are made into short pieces for carbonisation. The carbon from the slow pyrolysis process is in the form of lumps and this uneven sized carbon lumps are changed into uniform sized particle through pulverization. Pulverization is the process of grinding the uneven sized particle into uniform sized particle using pulverizer.

A binder is used for strengthening the briquettes. The carbonized char powder can be mixed with different binders such as commercial starch, rice powder, rice starch (rice boiled water) and other cost effective materials like clay soil and mixed in different proportions and shaped with the help of briquetting machine. For preparation of binding material starch is added to water in the ratio of 10:1 and allowed to disperse without any clumps. Then the solution is heated for 10 minutes but not allowed to boil. When starch is heated in water it forms a viscous, opaque paste. The liquid solution is added onto the char powder and mixed to ensure that every particle of carbonized char is coated with the binder. This process enhances charcoal adhesion and produce identical briquettes.

Briquetting plant needs different types of machineries to carry out the entire process of charcoal manufacturing. Depending on the initial moisture content and the nature of agro waste dryer unit is installed. Other equipment which may well be needed includes hogger or shredder. A separator is needed to remove stones, sand and so forth. A mill to comminute the raw material to very small size is also usually required. Binding and packaging may be required either to meet marketing or transport requirements

Collection of waste from the harvesting land and processing yard may be necessary and this will be constrained by the cost of transport and possibly also by logistical problem which could cause shortfalls in the supply of raw material. Prior to carbonization of agro waste it is essential to screen the waste to remove foreign matter such as soil etc., which could damage the pulverizer. With agricultural residues drying can be the most important stage in the process line. The method employed will depend on initial moisture content and equipment availability and costs.

3. ANALYSIS AND GENERAL CONSIDERATIONS

The proximate and ultimate analysis of prepared charcoal sample is done in the laboratory. Results are taken based on as received basis and air dry basis and are tabulated in Table 1.

Table 1: Analysis of Charcoal Briquettes

PROXIMATE ANALYSIS	Results
Total Moisture	23.00%
Inherent Moisture (Air Dry Basis)	6.85%
Ash(Air Dry Basis)	29.56%
Volatile Matter (Air Dry Basis)	23.48%
Fixed Carbon(Air Dry Basis)	40.11%
Gross Calorific value in kcal/kg (Air Dry Basis)	4,694
Gross Calorific value in kcal/kg (As Received Basis)	3,936
ULTIMATE ANALYSIS (Air Dry Basis)	
Moisture	6.85%
Mineral Matter	32.52%
Carbon	54.35%
Hydrogen	2.88%
Nitrogen	1.20%
Oxygen by Difference	1.88%
Sulphur	0.32%
WOOD	
Gross Calorific value in kcal/kg (As Received Basis)	6,460

The main advantage of briquetting pulverized powder are that the process produces a fuel which is both uniform in size and quality, while the necessary ultimate drying process further serves to increase the net calorific value of the briquettes per unit volume. The charcoal briquette burns without much smoke during ignition and burning and no sparks are produced like wood charcoal. Further, it contains minimum residual ash and evaporative substances and thus eliminating the possibility of odour.

CONCLUSION

Agricultural wastes are creating lot of health and environments problems in our daily activities. These problems are reduced through converting them into useful form. The charcoal prepared are economically cheaper and low cost compared to commercial carbon. It can also have good heating capacity, so this can be used as effective fuel.

REFERENCES

[1]. Tripati AK, Iyer PVR, Kandpal TC, "A Techno economic evaluation of biomass briquetting in India," Biomass Bioenergy 1998; Vol 14 (5-6), PP. 478-488.

[2]. Dr. P. Sugumaran, Program Director, Dr. S. Seshadri, Director (R&D), Shri AMM Murugappa Chettiar Research Centre, Taramani, Chennai, "A Booklet on Biomass Charcoal Briquetting."

[3]. S. Shenbagavalli, S.Mahimairaja, Dept of Environmental Sciences, Tamil Nadu Agricultural University, "Production and Characterization of biochar from different biological wastes, International Journal of Plant, Animal and Environmental Sciences, Vol-2, Issue-1, Jan-Mar 2012, ISSN 2231-4490.