

# Production of high-density charcoal from wood resources

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## Abstract

Presently thinning materials of a forest and disposition of the scrap wood have become a big issue in Japan. In our research, we produce a high-density charcoal from these woods. This high-density charcoal is substituted for coke made from coal. This coke is used in the Fused reduction method for garbage treatment. The coke in this method is produced by caking coal and is too expensive now, because of difficulty in getting the caking coal. It is necessary to produce this high-density charcoal in large quantities and at low price by comparison with the coke from caking coal. For that occasion, we developed a new type of carbonization furnace. This furnace is heated only by combustion energy from the exhausted gas during the carbonization without any heating resources such as oil and electricity, because the exhausted gas during the carbonization contains hydrogen, carbon mono-oxide and methane. We succeeded in producing high-density charcoal in large quantities and at low price by this new type of carbonization furnace.

Keywords: charcoal, wood, carbonization, carbonization furnace, coke

## 1. Introduction

Recently processing of thinned materials has been a big issue from effective use of resources for the environment. We produced a high density charcoal from wood materials and considered on substituteing it for coke from coal used in the Fused reduction method for garbage treatment. To substitute high density charcoal from wood materials for coke, high strength and slow reactivity with CO<sub>2</sub> is slow are required. The main subject of this process is how cheaply we could produce high density charcoal from wood powder. The carbonization furnace is one of the important. We made the new carbonization furnace which is heated by exhausted gas during carbonization. The furnace is heated without any outside heat resources such as electricity or oil.

## 2. Experimental and Results

### 2.1. High density materials from wood powder

Wood materials such as sawdust, bamboo bark of cedar and cypress are grained into powder. The powder is moulded under pressure and heat. Then we get the cylindrical high density wood. This high density wood is carbozed at 800 degree. These density of the wood and the carbon are measured. The results are shown in table1. Form these results the carbon from sawdust has high density. The sawdust is a good material for producing high density

charcoal.

Table 1 Bulk density before and after carbonization of samples

	Sawdust	Chaff	Bark
Bulk density before carbonization	1.27g/cm <sup>3</sup>	1.18g/cm <sup>3</sup>	1.21 g/cm <sup>3</sup>
Bulk density after carbonization	1.03g/cm <sup>3</sup>	0.43g/cm <sup>3</sup>	0.75 g/cm <sup>3</sup>

An extruding machine of hot forming for producing high density wood material is constructed, shown in fig.1.

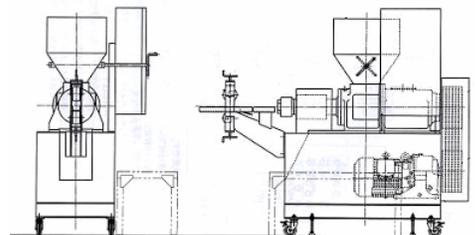


Fig.1 Extruding machine of hot forming for high density wood material

The high density wood is produced from sawdust in 100kg/hr from this machine. The water content of the sawdust must be under 5%. Steam eruption sometime happens, when the water content of sawdust is over 5%. The high density wood material is shown in fig.2.



Fig.2 high density wood material produced by the extruding machine

### 2.2. New carbonization furnace

High density carbon must be produced inexpensively. We know combustible gases such as carbon monoxide, hydrogen and methane are produced during carbonization of wood. These combustible gases are burned with oxygen for carbonization. At first, the heat balance of carbonization is calculated. The necessary heat for carbonization is compared with the generated heat during the carbonization. The heat input for 1000kg of dry wood is 1974 Mcal. On the contrary, The heat output is 1874 Mcal for carbonization of 1000kg wood. That means that wood is carbonized without any heating resources such as oil and electricity.

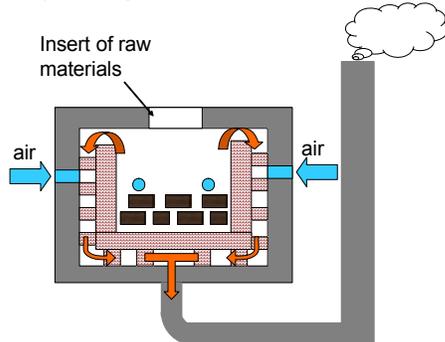


Fig.2 schematic figure of carbonization furnace

The new carbonization furnace is developed. The furnace is shown in fig.2. The furnace has double wall for flowing exhaust flame gas. The flowing exhaust flame heat the furnace for carbonization. The capacity of the furnace is about one cubic meter and productivity is about 250kg high density wood /one batch. The furnace has two doors and one hole. The hole is for inserting the high density wood. The furnace has also several holes of air for burning with the exhaust gas and the other holes for the thermocouples for measuring the temperature.

At first the scrapped wood are inserted from the insert hole on the ceiling of the furnace. The scrap wood is burned. The temperature of the inside block of the furnace is measured. When the temperature is about 1000degrees The door is opened, then the cinder is raked out from the door of the furnace. The high

density material from wood is inserted into the furnace, and then the door is closed. The holes for insert air are open. The exhausted gas is burned out. The open area of the air hole is adjusted for the temperature of the furnace. The temperature of the inside block of the furnace lowers, The air holes are closed, because volatile matter from the wood disappears.

Photo.1 shows the inside of the furnace. The inside has two spaces. The materials are put in the center of the inside, the exhaust gas flows from the center to the outside, and during this time the blocks are heated.



Photo.2 Inside of the furnace

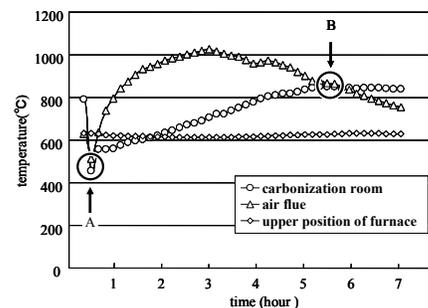


Fig. 3 Temperature distribution of the furnace

Fig.3 shows the temperature distribution of the furnace. The A point of the fig.3 is the time of inserting the materials. In the point B the temperature of the exhaust gas is lower than that of the carbonization room, this means the volatile matter from wood is almost off. After a few hours is kept for producing good charcoal. Then the door is opened. The charcoal is taken out(fig.4).



Fig.4 The charcoal is taken out from the furnace.

### ***3. Conclusions***

The high density material from powder wood is produced at about 180 degrees in high pressure mould method. This high density wood material is carbonized to produce carbon.

At that time the density of the carbon is related to the density of wood. An economical carbonization furnace is built, the heat for carbonization is only by the combustion heat of the exhausted gas during carbonization. The furnace with the practical scale is built and operated. The capacity of the internal volume is one cubic meter. The carbon produced from the new carbonization furnace is useful for using the Fused reduction method for garbage .