The activated charcoal according to the present invention has increased micro-pores and surface area. This allows for enhanced gasification properties compared to traditional charcoal. The invention also involves a method and apparatus for producing activated carbon of bamboo charcoal. The method comprises the steps of carbonizing bamboo pieces to prepare bamboo charcoal, loading the bamboo charcoal into a rotary kiln furnace to activate the bamboo charcoal. In the activation step, the bamboo charcoal particles are activated by water gasification with steam supplied from a steam supply pipe. The activated charcoal is recycled to improve heating efficiency and promote water gasification of the charcoal particles in the heated bamboo charcoal. As a result, the activated charcoal according to the present invention has increased micro-pores and surface area.
Description

ACTIVE BAMBOO CHARCOAL PRODUCING METHOD AND APPARATUS

Technical Field

[1] The present invention relates to a method and apparatus for producing bamboo activated charcoal. More particularly, it relates to a method and apparatus for producing bamboo activated charcoal, in which the improvement comprises increasing micro-pores and surface area to produce bamboo activated charcoal with improved quality.

Background Art

[2] Generally, the bamboo activated charcoal has micro-porous structure and through insertion of beneficial microorganisms on the surface or adsorption of impurities and microorganisms, based on acidity and activation point on the micro-surface, it can be widely used to purify air and water. Also, it can be used to inhibit generation of saprogenous bacteria, to remove offensive odor by adsorption of causative substances of the offensive odor and to control humidity.

[3] The bamboo activated charcoal is produced by heating pieces and particles of bamboo charcoal in a carbonizing apparatus, for example a rotary kiln furnace at a high temperature of 800 to 1200°C and supplying steam to the bamboo charcoal in the red heat state, upon which various gasification reactions (activation reaction) including the following endothermic reactions occur.

[4] That is,

[5] \( C + H_2O \rightarrow CO + H_2 \)

[6] \( CO + H_2O \rightarrow CO_2 + H_2 \)

[7] \( C + 2H_2O \rightarrow CO_2 + 2H_2 \)

[8] \( C + CO_2 \rightarrow 2CO \)

[9] Since the activation reaction is the endothermic reaction, the internal temperature of the kiln furnace can be rapidly lowered, a heating apparatus should be provided to maintain the internal temperature in the range of 800 to 1200°C.

[10] Though numerous micro-pores are formed on the bamboo activated charcoal by the activation reaction, charcoal can be combusted at an excessively high temperature during the activation. If the temperature is too low, the carbonization takes a long period of time, deteriorating productivity and only a small amount of micro-pores are formed, deteriorating quality of the bamboo activated charcoal. Also, the carbonization for a long period of time increases fuel expenses. Thus, the temperature control in the activation furnace is the critical subject in the apparatus for producing bamboo
activated charcoal.

Disclosure of Invention

Technical Problem

Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the prior art, and it is an object of the present invention to provide a method for producing bamboo activated charcoal by promoting activation reaction while minimizing the structural modification of a rotary kiln furnace to rapidly form micro-pores.

Also, it is another object of the present invention to provide an apparatus for producing bamboo activated charcoal, in which a part of exhaust gas including carbon monoxide is supplied to a region near the outlet of a rotary kiln furnace so that the activation reaction is promoted and thereby, more micro-pores can be formed.

Technical Solution

To accomplish the above objects of the present invention, according to the present invention, there is provided a method for producing bamboo activated charcoal comprising the steps of:

1. carbonizing chopped bamboo to prepare bamboo charcoal; and
2. loading the bamboo charcoal in a rotary kiln furnace and activating the bamboo charcoal to increase micro-pores and surface area of the bamboo charcoal particles, in which
   - the activation of the bamboo charcoal is performed by water gasification of the bamboo charcoal particles heated by steam supplied from a steam supply pipe and a part of the exhaust gas is recycled to promote the water gasification of carbons in the heated bamboo charcoal particles.
3. Also, the apparatus for producing bamboo activated charcoal according to the present invention comprises a rotary kiln furnace having a column shape and rotatably installed such as to be supported by a supporting roller, a burner installed at the side of an inlet, through which the bamboo charcoal is loaded, a steam supply pipe installed extendedly from the inlet of the rotary kiln furnace to the inside thereof to supply steam for water gasification of the bamboo charcoal and a reflux gas supply pipe installed inside the rotary kiln furnace to supply activating gas containing carbon monoxide to the inside of the rotary kiln furnace by recycling a part of the exhaust gas using a blower at the outlet side of the rotary kiln furnace, thereby promoting water gasification reaction of bamboo charcoal in the rotary kiln furnace.

Advantageous Effects

According to method for producing bamboo activated charcoal of the present invention, bamboo charcoal is loaded to a rotary kiln furnace and heated using a burner
while supplying steam, upon which carbons of the bamboo charcoal particles in the red heat state reacts with water through the water gasification reaction to produce carbon monoxide, carbon dioxide and bamboo activated charcoal. Particularly, a part of the exhaust gas containing carbon monoxide is recycled through a supply pipe from the outlet to promote activation of the bamboo activated charcoal. As a result, micro-pores and surface area of the bamboo activated charcoal, whereby adsorption of the bamboo activated charcoal is more improved, activation is more rapidly accomplished through water gasification performed by loading of bamboo charcoal, red heating and steam supplying and the fuel cost is reduced.

**Brief Description of the Drawings**

[19] Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

[20] FIG. 1 is a schematic lengthwise cross-sectional view of the rotary kiln furnace for performing the method for producing bamboo activated charcoal according to the present invention; and

[21] FIG. 2 is a cross-sectional view taken the line A-A of FIG. 1.

**Best Mode for Carrying Out the Invention**

[22] Now, the method for producing bamboo activated charcoal according to the present invention is explained in detail.

[23] In FIG. 1 and FIG. 2, schematically shown is the structure of the rotary kiln furnace for performing the method for producing bamboo activated charcoal according to the present invention.

[24] The apparatus for producing bamboo activated charcoal according to the present invention has a kiln furnace structure and comprises a rotary kiln furnace 2 having a column shape and rotatably installed such as to be supported by a supporting roller, a burner 3 installed at the side of an inlet, through which the bamboo charcoal is loaded and a steam supply pipe 4 for supplying steam for water gasification.

[25] Also, at the outlet side of the rotary kiln furnace 2, a gas supply pipe 20 is installed extending to the inside of the rotary kiln furnace to recycle and supply a part of the exhaust gas containing carbon monoxide, which promotes the activation reaction of bamboo charcoal.

[26] Now, the method for producing bamboo activated charcoal using the apparatus for producing bamboo activated charcoal.

[27] Bamboo charcoal pieces which are the material for bamboo activated charcoal are supplied to the inside of the rotary kiln furnace 2 from a hopper 1 by a screw conveyor.

[28] The kiln furnace 2 has a column shape and is open at the inlet side so that the
bamboo charcoal particles are supplied from the hopper by the conveyor. Also, it is provided with a burner 3 to heat the inside of the kiln furnace and a steam supply pipe 4 to supply steam at a high temperature for the gasification reaction from a steam supply apparatus (not shown). Further, at the outlet side, an outlet port 5 is provided to discharge the bamboo activated charcoal along with gas and a supporting apparatus 6 is provided to rotatably support the kiln furnace 2.

At the inlet side of the kiln furnace, a drain part 7 is installed to rotatably support the kiln furnace 2 and collect bamboo charcoal particles discharged through the open inlet when introduced to the kiln furnace and its inlet is closed upon operation of the kiln furnace.

The kiln furnace 2 is rotatably supported by supporting rollers 10 at both side as shown in the cross-sectional view of Fig. 2 and the supporting rollers are provided with cushioning member 11 such as tire so that the kiln furnace can rotate without damage caused by impact against the supporting rollers.

The kiln furnace 2 is disposed at a tilt of 2° - 8° so that the inlet side is higher than the outlet side. As a result, the bamboo charcoal loaded into the kiln furnace is automatically transported to the outlet side as it is activated in the rotating furnace.

A gear 12 is integratedly installed around the circumference of the kiln furnace in the inner part from the end parts at both sides of the kiln furnace 2 and rotates while engaging with a pinion gear 16 operated by a motor 15 to revolve the kiln furnace 2.

In the kiln furnace structure, a part of the exhaust gas containing carbon monoxide supplied through a gas supply pipe 20 installed extending from the outlet to the inside is recycled through a collecting pipe 22 to promote the activation reaction by a blower 21.

The recycling gas supply pipe 20 is preferably disposed to align with the rotating axis of the kiln furnace 2 or incline upward at about 2 to 5° so that the bamboo activated charcoal particles at the bottom are not dispersed while the kiln furnace rotates.

Now, the method for producing bamboo activated charcoal in the rotary kiln furnace having the above-described structure according to the present invention is described.

In order to produce bamboo activated charcoal, bamboo pieces are prepared into bamboo charcoal in the first step and the bamboo charcoal is activated to prepare activated charcoal in the second step.

In the first step for producing bamboo charcoal, bamboo is chopped to a uniform size, for example a size of 2D to 3D and stored in a hopper 1 of FIG. 1. The rotary kiln furnace 2 is pre-heated by a burner 3 to 600°C. After pre-heating of the rotary kiln furnace 2, a small amount of the bamboo pieces stored in the hopper is loaded to the
rotary kiln furnace by a transporting means such as screw conveyor provided at the bottom of the hopper. As the loaded bamboo pieces are carbonized, the internal temperature of the rotary kiln furnace is raised.

When 8 to 10 hours passed after bamboo pieces are loaded, the internal temperature of the rotary kiln furnace reaches about 800°C. From this point, bamboo pieces are supplied at a uniform rate from the hopper 1 to the rotary kiln furnace.

The rotating rate of the kiln furnace is set so that the bamboo pieces are loaded, moves through the internal space of the rotary kiln furnace 2 as the furnace rotates at a tilt and discharged after carbonization in about 4 hours.

From 2 hours after the bamboo pieces is loaded into the rotary kiln furnace, steam is introduced through the steam supply pipe 4 to prevent the bamboo charcoal from being excessively oxidized. Thus, the bamboo pieces are discharged through the outlet as bamboo charcoal 4 hours later after the pieces has been loaded to the rotary kiln furnace. The produced bamboo charcoal can be used as general charcoal and be also sued as raw material for bamboo activated charcoal.

In the above description, the bamboo pieces are carbonized to bamboo charcoal in the rotary kiln furnace 2. However, the bamboo charcoal can be prepared by conventional method and apparatus for producing charcoal preparation and used as raw material of bamboo activated charcoal as described below.

In the second step of the method for producing activated charcoal of bamboo charcoal, the bamboo charcoal prepared in the first step is loaded through the hopper 1 and continuously introduced to the inside of the kiln furnace by a screw feeder. Then, the charcoal is heated at 800 to 1200°C to the red heat state in the region near the inlet side. While the charcoal moves to the center and the outlet side as the kiln furnace rotates at a tilt, the charcoal undergoes activation reaction, in which carbon contained in the bamboo charcoal reacts with water molecule in the steam supplied by the steam supply pipe 4 to generate carbon monoxide and hydrogen and secondly carbon monoxide reacts with water molecule to generate carbon dioxide and hydrogen molecule.

Hear, as the carbon atoms contained in the bamboo charcoal react with water molecule to produce carbon monoxide and carbon dioxide, the micro-pores in the bamboo charcoal get bigger and new micro-pores are formed. Meanwhile, by supplying the exhaust gas containing carbon monoxide through the gas supplying pipe 20, the activation reaction is more promoted, whereby the time taken for the activation is shortened and thereby, the energy consumption is reduced, while producing excellent quality bamboo activated charcoal with well-developed surface area.

Additional equipment can be provided to collect heat from the activated charcoal and gas kiln furnace in the supporting apparatus 6 at the outlet side. Refractory bricks
may be used in the kiln furnace, the drain parts at the inlet side and the supporting apparatus at the outlet side.
Claims

[1] A method for producing bamboo activated charcoal comprising the steps of: carbonizing chopped bamboo by heating at 500 to 800°C to prepare bamboo charcoal with micro-pores formed; and loading the bamboo charcoal in a rotary kiln furnace and activating the bamboo charcoal to increase micro-pores and surface area of the bamboo charcoal particles, wherein the activation of the bamboo charcoal is performed by water gasification of the bamboo charcoal particles heated by steam supplied from steam supply pipe at a temperature of 800 to 1200°C and carbon monoxide is supplied to promote activation of carbons in the heated bamboo charcoal particles.

[2] The method according to claim 1, wherein the carbon monoxide is supplied by collecting the exhaust gas.

[3] An apparatus for producing bamboo activated charcoal comprising a rotary kiln furnace having a column shape and rotatably installed such as to be supported by a supporting roller, a burner installed at the side of the inlet through which the bamboo charcoal is loaded, a steam supply pipe extendedly installed from the inlet of the rotary kiln furnace to the inside thereof to supply steam for water gasification of the bamboo charcoal and a reflux gas supply pipe installed inside the rotary kiln furnace to supply the reflux gas containing carbon monoxide bamboo charcoal by collecting exhaust gas using a blower at the side of the outlet of the rotary kiln furnace, thereby promoting the activation of bamboo charcoal to the inside of the rotary kiln furnace.
### A. CLASSIFICATION OF SUBJECT MATTER

**COIB 31/10(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC.

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**KOREA UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPOPSS(KIPO Internal), PAJ

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☑ Further documents are listed in the continuation of Box C  ☒ See patent family annex

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Date of the actual completion of the international search

25 JUNE 2007 (25 06 2007)

Date of mailing of the international search report

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