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(54) **SYSTEM AND METHOD FOR REFINEMENT OF CHAR AND MANUFACTURE OF REGENERATED CARBON BLACK THROUGH WASTE TIRE PYROLYSIS**

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(57) **ABSTRACT**

The present invention includes a system and a method for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis, wherein, in a process of refining char obtained through a pyrolysis process of a waste tires, volatile constituents of char are preferentially removed prior to molding using a pyrolysis furnace having a continuous-type configuration and capable of operating in a continuous manner, and microparticular or microparticle-type regenerated carbon black is produced using the resulting char of increased purity as a material and then molded into spheres with water serving as a binder, whereby regenerated carbon black of high quality can be produced, with the concomitant achievement of cost reduction and an increase in output in the process of producing corresponding spherical regenerated carbon black.

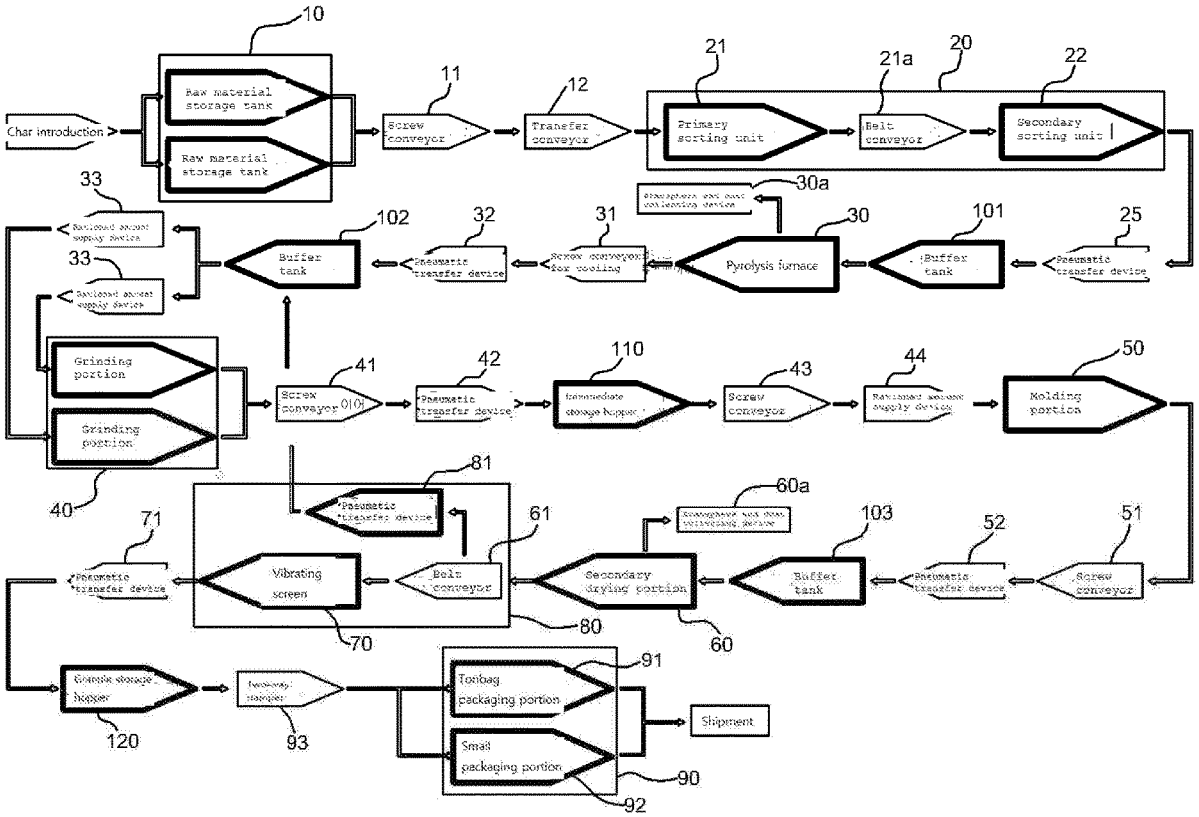


FIG. 1

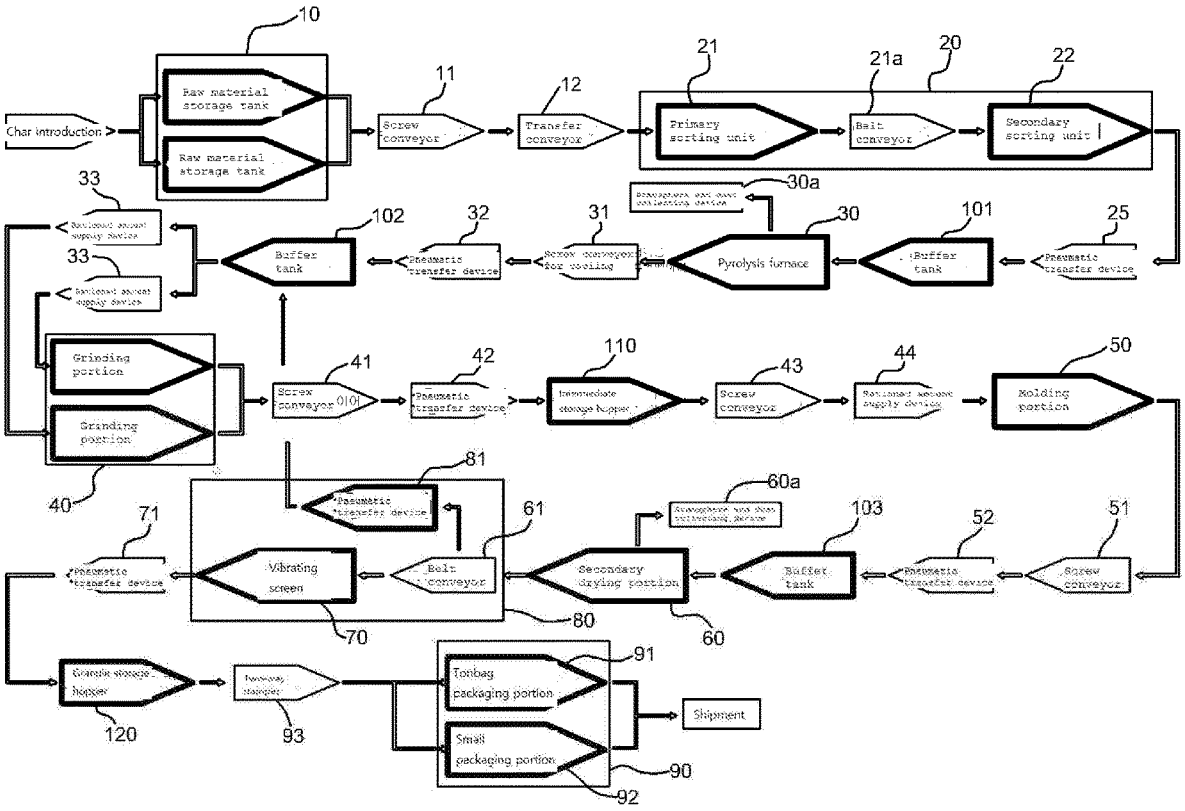

10
Char introduction
Raw material storage tank
Raw material storage tank
11
Screw conveyor
12
Transfer conveyor
21
Primary sorting unit
21a
20
Belt conveyor
22
Secondary sorting unit
30a
33
33
102
Buffer tank
32
Pneumatic transfer device
31
Screw conveyor for cooling
30
Pyrolysis furnace
101
Buffer tank
25
Pneumatic transfer device
Grinding portion
Grinding portion
40
41
Screw conveyor
42
Pneumatic transfer device
110
Intermediate storage hopper
43
Screw conveyor
44
50
Molding portion
81
Pneumatic transfer device
60a
71
Pneumatic transfer device
Vibrating screen
61
Belt conveyor
Secondary drying portion
103
Buffer tank
52
Pneumatic transfer device
51
Screw conveyor
70
80
60
Granule storage hopper
120
93
91
Ton-bag packaging portion
Small packaging portion
92
90
Shipment

FIG. 2

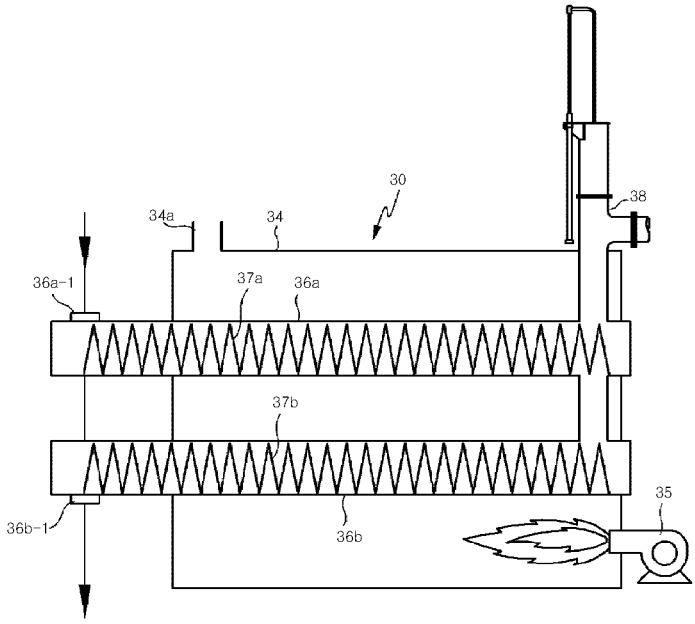


FIG. 3

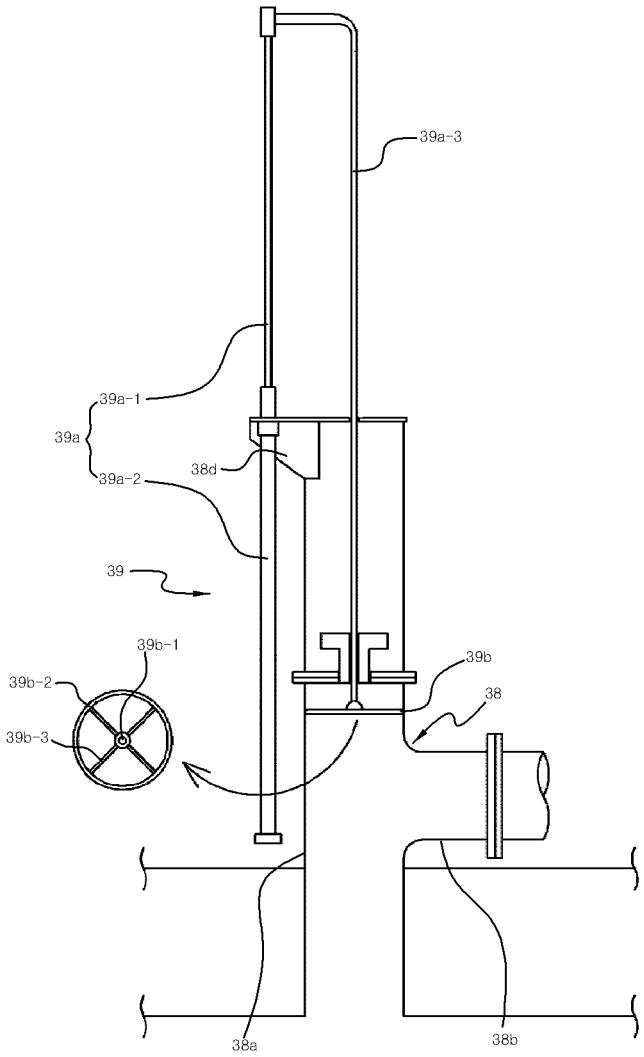


FIG. 4

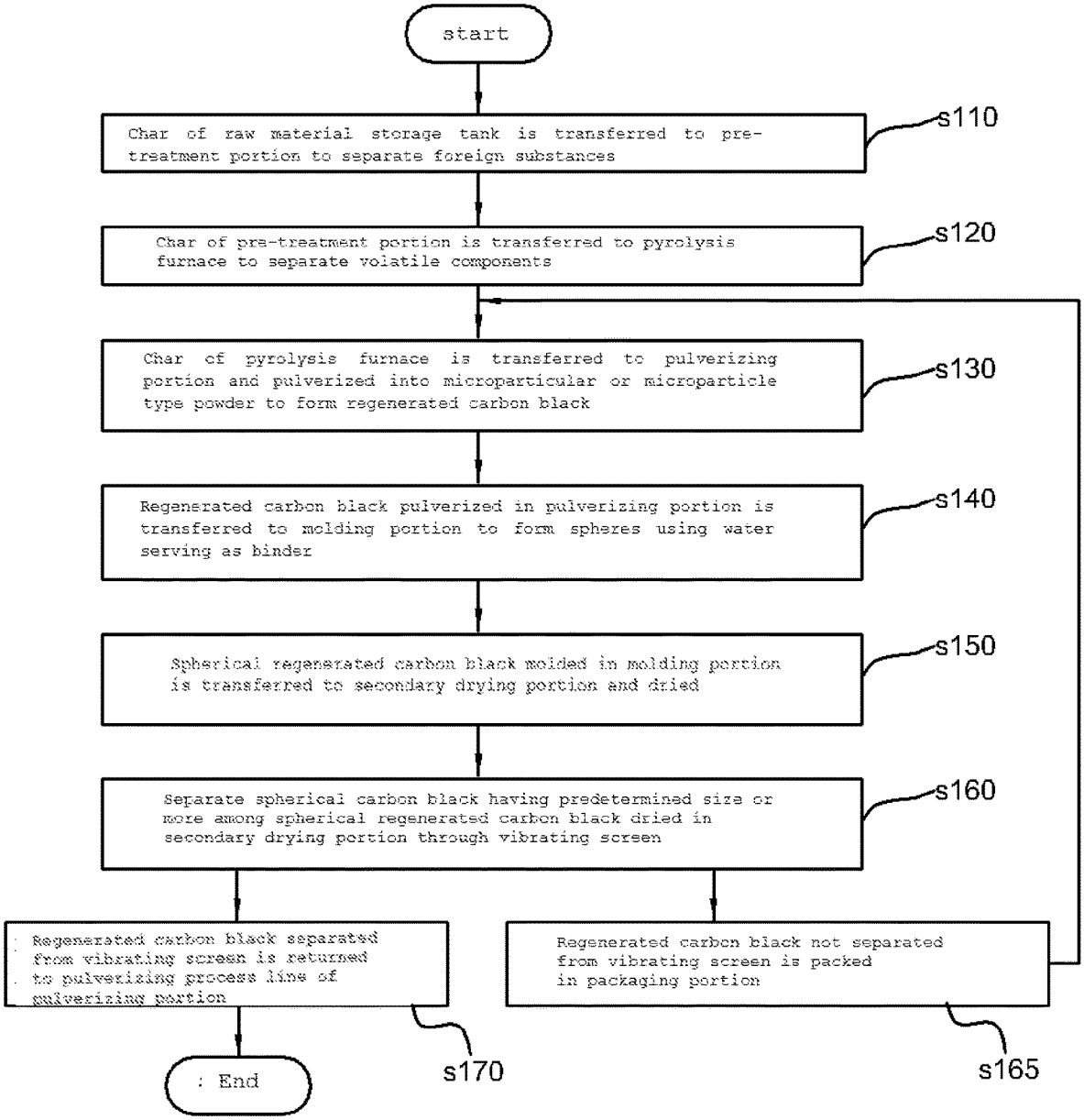
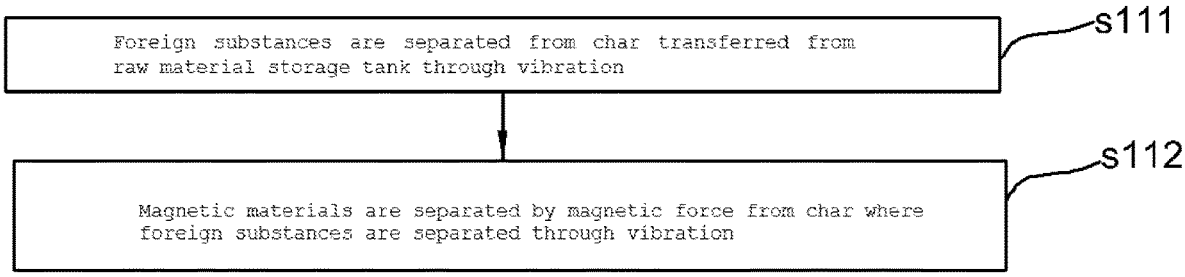

start
Char of raw material storage tank is transferred to pre-treatment portion to separate foreign substances
s110
Char of pre-treatment portion is transferred to pyrolysis furnace to separate volatile components
s120
Char of pyrolysis furnace is transferred to pulverizing portion and pulverized into microparticular or microparticle type powder to form regenerated carbon black
s130
Regenerated carbon black pulverized in pulverizing portion is transferred to molding portion to form spheres using water serving as binder
s140
Spherical regenerated carbon black molded in molding portion is transferred to secondary drying portion and dried
s150
Separate spherical carbon black having predetermined size or more among spherical regenerated carbon black dried in secondary drying portion through vibrating screen
s160
Regenerated carbon black separated from vibrating screen is returned to pulverizing process line of pulverizing portion
Regenerated carbon black not separated from vibrating screen is packed in packaging portion
End
s170
s165

FIG. 5


Foreign substances are separated from char transferred from raw material storage tank through vibration
s111
Magnetic materials are separated by magnetic force from char where foreign substances are separated through vibration
s112

SYSTEM AND METHOD FOR REFINEMENT OF CHAR AND MANUFACTURE OF REGENERATED CARBON BLACK THROUGH WASTE TIRE PYROLYSIS

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a system and a method for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis, wherein, in a process of refining char obtained through a pyrolysis process of waste tires, volatile constituents of char are preferentially removed prior to molding using a pyrolysis furnace having a continuous-type configuration and capable of operating in a continuous manner, and microparticular or microparticle-type regenerated carbon black is produced using the resulting char of increased purity as a material and then molded into spheres with water serving as a binder, whereby regenerated carbon black of high quality can be produced, with the concomitant achievement of cost reduction and an increase in output in the process of producing corresponding spherical regenerated carbon black.

2. Description of the Prior Art

[0002] In general, pyrolysis refers to decomposition of an organic substance by indirectly heating the organic substance in an oxygen-free state. When heat is applied to a polymer organic substance, the molecular structure is destroyed, and at the same time, a pyrolysis gas is generated, and by-products converted into relatively simple low molecular materials can be obtained by condensing the generated pyrolysis gas. Examples of such by-products may include solid carbon, liquid oil, and non-condensable gas.

[0003] When thermally decomposing polymer compounds such as waste tires, waste rubbers, vinyl, plastics, and leather sludge by using a pyrolysis device for recovering oil and carbon, the gas generated during pyrolysis is discharged through an exhaust pipe, the discharged gas is cooled and refined to obtain an oil, and the pyrolysis device for the above purpose is typically configured to include a pyrolysis furnace.

[0004] A conventional pyrolysis furnace includes a solid outlet for discharging solid components that are thermally decomposed, a gas outlet for discharging gas components containing oil components, an inlet for receiving organic substances to be treated, a burner for heating an inside of the pyrolysis furnace, and a transfer device for transferring the introduced organic substances to the solid outlet.

[0005] However, since the conventional pyrolysis furnace having the above-described configuration is a batch type, it is possible to selectively close the inlet and the solid outlet, so it is suitable for maintaining the inside of the pyrolysis furnace in an oxygen-free state, but the yield rate is relatively low and the purity of the solid material is low when compared to a continuous pyrolysis furnace. For example, in the case of the waste tire, when the waste tire is thermally decomposed through the above-described batch type pyrolysis furnace, a relatively large amount of volatile components is contained in a char which is a solid material, so that the purity of the char is not high.

[0006] Meanwhile, carbon black used in the manufacture of tires is an essential additive that increases the bonding strength of rubber which is the main component of tires, and requires high purity of 99% or more.

[0007] In addition, as a method for recovering the carbon black from the waste tires, a pyrolysis process is widely used as described above.

[0008] However, the purity of the char obtained through the pyrolysis process of the waste tires is degraded to 78 to 82% due to other additives used for producing the tires.

[0009] The main reasons causing the quality degradation in the char obtained through the pyrolysis process of the waste tires are residual volatile substances introduced in the pyrolysis process and inorganic additives used as additives. The inorganic additives mainly include sulfur, zinc oxide (ZnO), magnesium oxide (MgO), silica (SiO_2), calcium carbonate ($CaCO_3$), iron oxide (Fe_2O_3), and the like.

[0010] Further, as described above, when the purity of the char obtained through the pyrolysis process of the waste tires is low, it leads to a degradation in the quality of the regenerated carbon black obtained from the char. Thus, there is a need to provide a method of improving the purity of the char serving as a raw material for the regenerated carbon black and producing a high-quality regenerated carbon black by using the char having the high purity.

RELATED ART DOCUMENTS

Patent Documents

[0011] (Patent Document 1) Korean Registered Patent No. 10-1213754 (issued on Dec. 18, 2012), "Pyrolysis furnace".

[0012] (Patent Document 2) Korean Registered Patent No. 10-1121569 (issued on Mar. 6, 2012), "Method for upgrade-processing carbon black produced by performing a pyrolysis process on waste tires".

SUMMARY OF THE INVENTION

[0013] An embodiment of the present invention provides a system and a method for the refinement of char and the manufacture of regenerated carbon black through a pyrolysis process of waste tires, in which a process for producing the regenerated carbon black by refining the char obtained through the pyrolysis process of waste tires is continuously and sequentially performed through a series of processes in an optimum order, and as a result, the quality of the regenerated carbon black obtained through the refinement of char and molded in a spherical shape is remarkably improved.

[0014] In addition, an embodiment of the present invention provides a system and a method for the refinement of char and the manufacture of regenerated carbon black through a pyrolysis process of waste tires, in which volatile components of the char is primarily removed prior to molding during the refinement of the char obtained through the pyrolysis process of waste tires to increase the purity of the char, and then, microparticular or microparticle-type regenerated carbon black is produced using the char having the high purity as a raw material and then molded into spheres with water serving as a binder, whereby regenerated carbon black of high quality can be produced, with the concomitant achievement of cost reduction and an increase in output in the process of producing corresponding spherical regenerated carbon black.

[0015] Further, an embodiment of the present invention provides a system and a method for the refinement of char

and the manufacture of regenerated carbon black through a pyrolysis process of waste tires, in which volatile components of the char obtained through the pyrolysis process of the waste tires are primarily removed by using a continuous-type pyrolysis furnace having a structure capable performing continuous operations to increase the purity of the char and the regenerated carbon black is produced by using the char as a raw material.

[0016] A system for refining char and manufacturing regenerated carbon black through waste tire pyrolysis according to one embodiment of the present invention includes: a raw material storage tank in which the char obtained through pyrolysis of waste tires is stored; a pre-treatment portion for separating foreign substances by sorting at least two times the char transferred from the raw material storage tank; a pyrolysis furnace for separating volatile components of the char transferred from the pre-treatment portion; a pulverizing portion for pulverizing the char transferred from the pyrolysis furnace into microparticular or microparticle powder to form regenerated carbon black; a molding portion for molding the regenerated carbon black transferred from the pulverizing portion into a spherical shape using water as a binder; a secondary drying portion for drying the spherical regenerated carbon black transferred from the molding portion; a vibration screen for separating the spherical regenerated carbon black having a predetermined size or more among the spherical regenerated carbon blacks transferred from the secondary drying portion; a packaging portion for packaging the spherical regenerated carbon blacks transferred from the vibration screen in a unit of a predetermined amount; and a returning portion for returning the spherical regenerated carbon black separated by the vibration screen to a process line where pulverization is performed through the pulverizing portion.

[0017] The pyrolysis furnace may include: a housing; a burner for heating an inside of the housing; a first chamber horizontally installed inside the housing in a state where one longitudinal end thereof is exposed out of the housing, in which an inlet for the char transferred from the pre-treatment portion is formed at the one longitudinal end exposed out of the housing; a second chamber disposed inside the housing in parallel to the first chamber, positioned below the first chamber, having one end arranged in a same direction as the one end formed with the inlet of the first chamber and exposed out of the housing in which an outlet for the char is formed at the exposed one end, and having an opposite end which is opposite to the outlet and connected to an opposite end of the first chamber which is opposite to the inlet of the first chamber; a first transfer portion for transferring the char flowing into the first chamber through the inlet to an opposite side; a second transfer portion for transferring the char flowing into the second chamber through the first chamber toward the outlet; and a gas release pipe having one longitudinal end connected to the one end of the first chamber opposite to the inlet to communicate with an inside of the first chamber, and an opposite longitudinal end drawn out of the housing.

[0018] In addition, the pyrolysis furnace may further include an anti-clogging portion installed in the gas release pipe to remove materials adhering to an inner surface of the gas release pipe by scraping the materials.

[0019] Further, the gas release pipe may be configured in a shape in which a horizontal pipe branches from a central portion of a vertical pipe and a lower end of the vertical pipe is connected to the first chamber, and the anti-clogging portion may include: a cylinder which is installed on an upper end of the vertical pipe and disposed such that a front end of a rod reciprocates in a longitudinal direction of the vertical pipe within the vertical pipe; and a scraper including a hub coupled to the front end of the rod of the cylinder, a ring-shaped portion having a size adapted to make contact with an inner surface of the vertical pipe, and a plurality of ribs, in which both longitudinal ends of the ribs are fixed to the hub and the ring-shaped portion, respectively.

[0020] In addition, the secondary drying portion may include a conveyor belt and may be configured to dry the spherical regenerated carbon black transferred along the conveyor belt by applying heat to the spherical regenerated carbon black.

[0021] In addition, a method for refining char and manufacturing regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention includes: transferring the char, which is obtained through pyrolysis of waste tires, from a raw material storage tank where the char is stored to a pre-treatment portion to separate foreign substances by sorting the char at least two times; transferring the char from the pre-treatment portion to a pyrolysis furnace and separating volatile components of the char by heating the char that moves along first and second chambers, which are installed in the pyrolysis furnace in parallel to each other while being spaced apart from each other in a longitudinal direction and in which both ends of the first and second chambers located in a same direction based on a longitudinal direction are connected to each other; transferring the char that has passed through the pyrolysis furnace to a pulverizing portion to form regenerated carbon black by pulverizing the char into microparticular or microparticle powder; transferring the regenerated carbon black formed through the pulverizing portion to a molding portion to form spherical regenerated carbon black using water as a binder; transferring the spherical regenerated carbon black processed through the molding portion to a secondary drying portion to dry the spherical regenerated carbon black; separating the spherical regenerated carbon black having a predetermined size or more among the spherical regenerated carbon blacks through a vibration screen after the spherical regenerated carbon black is dried through the secondary drying portion; transferring the spherical regenerated carbon black, which is not separated through the vibration screen, to a packaging portion to package the spherical regenerated carbon black in a unit of a predetermined amount; and transferring the spherical regenerated carbon black separated through the vibration screen to a process line where pulverization is performed by the pulverizing portion.

[0022] Further, the method may further include periodically removing materials adhering to an inner surface of a gas release pipe of the pyrolysis furnace by using a cylinder and a scraper that reciprocates along the inner surface of the gas release pipe through power of the cylinder.

[0023] According to an embodiment of the present invention, the process for producing the regenerated carbon black by refining the char obtained through the pyrolysis process of waste tires is continuously and sequentially performed through a series of processes in an optimum order, and as a result, the quality of the regenerated carbon black obtained through the refinement of char and molded in a spherical shape can be remarkably improved.

[0024] In addition, volatile components of the char are primarily removed prior to molding during the refinement of the char obtained through the pyrolysis process of waste tires to increase the purity of the char, and then, microparticular or microparticle-type regenerated carbon black is produced using the char having the high purity as a raw material and then molded into spheres with water serving as a binder, whereby regenerated carbon black of high quality can be produced, with the concomitant achievement of cost reduction and an increase in output in the process of producing corresponding spherical regenerated carbon black.

[0025] Further, volatile components of the char obtained through the pyrolysis process of the waste tires can be primarily removed by using a continuous-type pyrolysis furnace having a structure capable performing continuous operations to increase the purity of the char and the regenerated carbon black can be produced by using the char as a raw material, so that the regenerated carbon black produced as a final product may have the high quality.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. **1** is a block diagram illustrating a system for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention.

[0027] FIG. **2** is a schematic view of a pyrolysis furnace used in a system for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention.

[0028] FIG. **3** is a view illustrating a main portion of a pyrolysis furnace according to the embodiment shown in FIG. **2**.

[0029] FIG. **4** is a flowchart illustrating a method for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention.

[0030] FIG. **5** is a flowchart illustrating details of some processes in a method for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0031] The following detailed description of the present invention is an embodiment in which the present invention may be implemented and reference is made to the accompanying drawings shown as examples of the embodiment. These embodiments are described in detail so that those skilled in the art may readily implement the present invention. It should be understood that the various embodiments of the present invention are different, but need not be mutually exclusive. For example, the specific shapes, structures, and properties described herein in relation to one embodiment may be implemented in other embodiments without departing from the spirit and scope of the present invention. In addition, it should be understood that the position or arrangement of individual components in each embodiment may be changed without departing from the spirit and scope of the present invention.

[0032] Accordingly, the detailed description to be described below is not intended to be taken in a limiting sense, and if appropriately described, the scope of the present invention is limited only by the appended claims and equivalents thereof. Like reference numerals in the drawings refer to the same or similar functions throughout the several aspects.

[0033] Although the terms used in the present invention are preferably selected with general terms which are widely used at present under the consideration of functions in the present invention, the terms may vary according to the intention of those of ordinary skill in the art, judicial precedents, or introduction of new technology. In addition, in a specific case, the applicant arbitrarily may select terms, and in this case, the meaning of the terms will be disclosed in a corresponding part of the detailed description of the invention in detail. Thus, the terms used in the present disclosure should be defined not by the simple names of the terms, but by the meaning of the terms and the contents throughout the present disclosure.

[0034] Throughout the specification, when a certain part 'includes' a certain element, unless explicitly described to the contrary, it means that other elements may be further included but not excluded. In addition, the term disclosed herein such as "unit" or "module" indicates a portion for processing at least one function or operation, and may be implemented in hardware, software, or a combination of hardware and software.

[0035] Hereinafter, a system and a method for refining carbon black through pyrolysis of waste tires according to embodiments of the present invention will be described with reference to FIGS. **1** to **5**.

[0036] First, a system for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention will be described with reference to FIGS. **1** to **3**.

[0037] FIG. **1** is a block diagram illustrating a system for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention.

[0038] As shown in the drawing, the system for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention may include a raw material storage tank **10**, a pre-treatment portion **20**, a pyrolysis furnace **30**, a pulverizing portion **40**, a molding portion **50**, a secondary drying portion **60**, a vibration screen **70**, a returning portion **80**, and a packaging portion **90**. In addition, the system for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention may include buffer tanks **101**, **102**, and **103**, an intermediate storage hopper **110**, and a granule storage hopper **120**.

[0039] The char obtained through pyrolysis of waste tires may be stored in the raw material storage tank **10**. In the present embodiment, the raw material storage tank **10** is configured as a silo, but the present invention is not limited thereto.

[0040] The pre-treatment portion **20** may separate foreign substances from the char transferred from the raw material storage tank **10** by sorting the char at least two times. The pre-treatment portion **20** may include a primary sorter **21** that separates the foreign substances by vibrating the char transferred from the raw material storage tank **10** and a second sorter **22** that separates magnetic materials from the

char transferred from the primary sorter **21** by using magnetic force, in which the primary sorter **21** may include a belt conveyor **21***a* having the vibration function.

[0041] In addition, the char may be transferred from the raw material storage tank **10** to the pre-treatment portion **20** by a screw conveyor **11** connected to the raw material storage tank **10** and a transfer conveyor **12** having one end connected to the screw conveyor **11** and the other end connected to the primary sorter **21** of the pre-treatment portion **20**.

[0042] The pyrolysis furnace **30** may separate volatile components of char transferred from the pre-treatment portion **20**. The pyrolysis furnace **30** may include an air and dust collector **30***a*.

[0043] In addition, the char may be transferred from the pre-treatment portion **20** to the pyrolysis furnace **30** through a pneumatic transfer device **25** using pneumatic pressure such as an air compressor.

[0044] Further, a buffer tank **101** may be installed on a char transfer line between the pre-treatment portion **20** and the pyrolysis furnace **30**, and accordingly, the char transferred from the pre-treatment portion **20** may be primarily stored in the buffer tank **101** and then transferred to the pyrolysis furnace **30**.

[0045] FIGS. **2** and **3** illustrate one embodiment of the pyrolysis furnace **30** described above, and the detailed configuration of the pyrolysis furnace **30** will be described with reference to FIGS. **2** and **3**.

[0046] FIG. **2** is a schematic view of the pyrolysis furnace used in a system for the refinement of char and the manufacture of regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention and FIG. **3** is a view illustrating a main portion of the pyrolysis furnace according to the embodiment shown in FIG. **2**.

[0047] As shown in the drawings, the pyrolysis furnace **30** may include a housing **34**, a burner **35**, a first chamber **36***a*, a second chamber **36***b*, a first transfer portion **37***a*, a second transfer portion **37***b*, and a gas release pipe **38**. In addition, the pyrolysis furnace **30** may further include an anti-clogging portion **39**.

[0048] The housing **34** may form an outer appearance of the pyrolysis furnace **30**, that is, the housing **34** may form a basic body of the pyrolysis furnace **30**. In addition, an exhaust gas outlet **34***a* for discharging exhaust gas of the burner **35** may be formed on an upper portion of the housing **34**, which will be described below.

[0049] The burner **35** may have the function of heating an inside of the housing **34**. In the present embodiment, as an example, the burner **35** may be formed at a lower side of the housing **34**, but the present invention is limited thereto. The burner **35** may be installed in one of various locations with various structures so far as the burner **35** can heat the inside of the housing **34**.

[0050] The first chamber **36***a* may be horizontally installed inside the housing **34** in a state in which one longitudinal end of the first chamber **36***a* is exposed out of the housing **34**, and an inlet **36***a*-**1** for the char transferred from the pre-treatment portion **20** of FIG. **1** may be formed at the one longitudinal end exposed out of the housing **34**.

[0051] The second chamber **36***b* may be disposed inside the housing **34** in parallel to the first chamber **36***a* and installed below the first chamber **36***a*. The second chamber **36***b* may have one end arranged in the same direction as the one end formed with the inlet **36***a*-**1** of the first chamber **36** and exposed out of the housing **34** in which an outlet **36***b*-**1** for the char is formed at the exposed one end. In addition, the second chamber **36***b* may have an opposite end which is opposite to the outlet **36***b*-**1** and connected to an opposite end of the first chamber **36***a* which is opposite to the inlet of the first chamber **36***a*.

[0052] The first transfer portion **37***a* may have the function of transferring the char, which flows into the first chamber **36***a* through the inlet **36***a*-**1** of the first chamber **36***a*, in the opposite direction. In the present embodiment, the first transfer portion **37***a* may be configured as a transfer screw installed in the longitudinal direction of the first chamber **36***a*, but the present invention is not limited thereto, and the first transfer portion **37***a* may have various configurations so far as the first transfer portion **37***a* can move the char in one direction in the first chamber **36***a*.

[0053] The second transfer portion **37***b* may transfer the char, which flows into the second chamber **36***b* through the first chamber **36***b*, toward the outlet **36***b*-**1** of the second chamber **36***b*. In the present embodiment, the second transfer portion **37***b* may be configured as a transfer screw installed in the longitudinal direction of the second chamber **36***b*, but the present invention is not limited thereto, and the second transfer portion **37***b* may have various configurations so far as the second transfer portion **37***b* can move the char in one direction in the second chamber **36***b*.

[0054] The gas release pipe **38** may have one longitudinal end connected to the one end of the first chamber **36***a* opposite to the inlet **36***a*-**1** to communicate with an inside of the first chamber **36***a*, and an opposite longitudinal end drawn out of the housing **34**. The gas release pipe **38** may be connected to equipment (not shown) that extracts oil contained in the gas.

[0055] The anti-clogging portion **39** may be installed in the gas release pipe **38** to remove materials adhering to an inner surface of the gas release pipe **38** by scraping.

[0056] In addition, the anti-clogging portion **39** may include a cylinder **39***a* and a scraper **39***b*. In order to install the anti-clogging portion **39** including the cylinder **39***a* and the scraper **39***b*, the gas release pipe **38** may be configured in a shape in which a horizontal pipe **38***b* branches from a central portion of a vertical pipe **38***a* and a lower end of the vertical pipe **38***a* is connected to the first chamber **36***a*. The horizontal pipe **38***b* may be connected to equipment (not shown) that extracts oil contained in the gas.

[0057] Accordingly, the cylinder **39***a* may be installed on an upper end of the vertical pipe **38***a* of the gas release pipe **380**, and at the same time, a front end of a rod **39***a*-**1** of the cylinder **39***a* may reciprocate in the longitudinal direction of the vertical pipe **38***a* of the gas release pipe **38** within the vertical pipe **38***a*.

[0058] In addition, the scraper **39***b* may include a hub **39***b*-**1** coupled to the front end of the rod **39***a*-**1** of the cylinder **39***a*, a ring-shaped portion **39***b*-**2** having a size adapted to make contact with an inner surface of the vertical pipe **38***a*, and a plurality of ribs **39***b*-**3**, in which both longitudinal ends of the ribs **39***b*-**3** are fixed to the hub **39***b*-**1** and the ring-shaped portion **39***b*-**2**, respectively.

[0059] More specifically, regarding the configuration of the cylinder **39***a*, the cylinder **39***a* may include a cylinder body **39***a*-**2**, which is fixedly installed to a bracket **38***d* coupled to one side of the vertical pipe **38***a* of the gas release pipe **38***a*, and an inverse L-shaped rod **39***a*-**3** having one

longitudinal end coupled to the front end of the rod **39***a*-**1** of the cylinder body **39***a*-**2** and an opposite longitudinal end extending into the vertical pipe **38***a* of the gas release pipe **38** by passing through a horizontal cover plate **38***c*. The horizontal cover plate **38***c* may have the function of closing the upper end of the vertical pipe **38***a* of the gas release pipe **38**, and the bracket **38***d* may be fixed to one side of the horizontal cover plate **38***c*. In addition, the scraper **39***b* may be coupled to the front end of the inverse L-shaped rod **39***a*-**3**.

[0060] Referring to the operation of the pyrolysis furnace **30** having the above-described configuration, the char introduced into the first chamber **36***a* through the inlet **36***a*-**1** of the first chamber **36***a* may be transferred in a direction opposite to the inlet **36***a*-**1** by the first transfer portion **37***a*, and the char may be heated by the burner **35** while being transferred.

[0061] Then, the char transferred through the first chamber **36***a* may flow into the inside of the second chamber **36***b* connected to the first chamber **36***a*, and thus the char flowing into the second chamber **36***b* may be transferred toward the outlet **36***b*-**1** of the second chamber **36***b* by the second transfer portion **37***b* and heated by the burner **35** while being transferred. Then, the char moved along the second chamber **36***b* may be discharged through the outlet **36***b*-**1** of the second chamber **36***b* and transferred to the pulverizing portion **40** to be described below.

[0062] In addition, the gas that is thermally decomposed as the char is transferred through the first chamber **36***a* and the second chamber **36***b* may be discharged to oil extraction equipment via the vertical pipe **38***a* and the horizontal pipe **38***b* of the gas release pipe **38**.

[0063] Then, the anti-clogging portion **39** may be periodically operated, and accordingly, the inverse L-shaped rod **39***a*-**3** interworking with the rod **39***a*-**1** of the cylinder body **39***a*-**2** may reciprocate up and down along the vertical pipe **38***a* of the gas release pipe **38**. As the inverse L-shaped rod **39***a*-**3** reciprocates up and down, the scraper **39***b* may also reciprocate up and down, so that solid materials sticking to the inner surface of the vertical pipe **38***a*, that is, carbon particles that are scattered and adhered to the inner surface of the vertical pipe **38***a* together with the oil may be scraped off.

[0064] Returning again to FIG. **1**, the pulverizing portion **40** may pulverize the char transferred from the pyrolysis furnace **30** into microparticular or microparticle powder to form regenerated carbon black.

[0065] In addition, the char may be transferred from the pyrolysis furnace **30** to the pulverizing portion **40** by a cooling screw conveyor **31** for cooling and transferring the char discharged through the pyrolysis furnace **30** and a pneumatic transfer device **32** for transferring the char from the cooling screw conveyor **31** to the pulverizing portion **40** by using pneumatic pressure. In addition, the buffer tank **102** for primarily storing the char transferred from the pneumatic transfer device **32** and a quantitative supply device **33** for quantitatively supplying the char transferred from the buffer tank **102** in a unit of a predetermined amount may be further provided. Accordingly, the char that is primarily stored in the buffer tank **102** may be sequentially supplied to the pulverizing portion **40** in a unit of a predetermined amount through the quantitative supply device **33**.

[0066] The molding portion **50** may process the regenerated carbon black transferred from the pulverizing part **40** into a spherical shape using water as a binder.

[0067] In addition, the regenerated carbon black may be transferred from the pulverizing portion **40** to the molding portion **50** by a screw conveyor **41** for transferring the regenerated carbon black discharged from the pulverizing portion **40** and a pneumatic transfer device **42** for transferring the regenerated carbon black from the screw conveyor **41** to the molding portion **50** by using pneumatic pressure. In addition, an intermediate storage hopper **110** for primarily storing the regenerated carbon black discharged from the intermediate storage hopper **110**, a screw conveyer **43** for transferring the regenerated carbon black discharged from the intermediate storage hopper **110**, and a quantitative supply device **44** for quantitatively supplying the regenerated carbon black transferred from the screw conveyor **43** to the molding portion in a unit of a predetermined amount may be further provided. Accordingly, the regenerated carbon black that is primarily stored in the intermediate storage hopper **110** may be sequentially supplied to the molding portion **40** in a unit of a predetermined amount through the quantitative supply device **44**.

[0068] The secondary drying portion **60** may have a function of drying the spherical regenerated carbon black transferred from the molding portion **50**. The secondary drying portion may include a conveyor belt so that the spherical regenerated carbon black may be dried by heat applied to the spherical regenerated carbon black transferred along the conveyor belt. In addition, the secondary drying portion **60** may include an air and dust collector **60***a*.

[0069] Further, the spherical regenerated carbon black may be transferred from the molding portion **50** to the secondary drying portion **60** by a screw conveyor **51** for transferring the spherical regenerated carbon black discharged from the molding portion **50** and a pneumatic transfer device **52** for transferring the spherical regenerated carbon black from the screw conveyor **51** to the secondary drying portion **60** by using pneumatic pressure. In addition, a buffer tank **103** for primarily storing the spherical regenerated carbon black transferred from the pneumatic transfer device **52** may be installed. Accordingly, after the spherical regenerated carbon black has been primarily stored in the buffer tank **103**, the spherical regenerated carbon black of **103** may be transferred to the secondary drying portion **60**.

[0070] The vibration screen **70** may separate the spherical regenerated carbon black having a predetermined size or more from among the spherical regenerated carbon blacks transferred from the secondary drying portion **60**.

[0071] The spherical regenerated carbon black may be transferred from the secondary drying portion **60** to the vibration screen **70** through a belt conveyor **61**.

[0072] The returning portion **80** may transfer the spherical regenerated carbon black separated by the vibration screen **70** to a process line where pulverization is performed through the pulverizing portion **40**. The returning portion **80** may include a pneumatic transfer device **81** to transfer the spherical regenerated carbon black separated by the vibration screen **70** to a pulverization process line through the pulverizing portion **40** by using pneumatic pressure.

[0073] The packaging portion **90** may pack the spherical regenerated carbon black transferred from the vibration screen **70** in a unit of a predetermined amount.

[0074] In addition, the spherical regenerated carbon black may be transferred from the vibration screen **70** to the packaging portion **90** by a pneumatic transfer device **71** that transfers the spherical regenerated carbon black discharged from the vibration screen **70** to the packaging portion **90** by using pneumatic pressure. In this case, a granule storage hopper **120** may be installed on a spherical regenerated carbon black transfer line between the vibration screen **70** and the packaging portion **90**. Accordingly, the spherical regenerated carbon black transferred from the vibration screen **70** may be primarily stored in the granule storage hopper **120**, and then the spherical regenerated carbon black of the granule storage hopper **120** may be transferred to the packaging portion **90**.

[0075] Further, the packaging portion **90** may include a ton bag packaging portion **91** and a small packaging portion **92**, and thus, the granule storage hopper **120** and the packaging portion **90** may be connected to each other through a two-way damper **93**. The spherical regenerated carbon black may be selectively transferred to the ton bag packaging portion **91** or the small packaging portion **92** through the two-way damper **93**.

[0076] According to the above configuration, the operation for manufacturing the regenerated carbon black by refining the char obtained through the pyrolysis process of the waste tires may be continuously and sequentially performed through a series of processes in the optimum order. As a result, the char can be refined with a high quality and the spherical regenerated carbon black may have high quality.

[0077] In addition, in the process of refining the char obtained through the pyrolysis process of waste tires, volatile components of the char can be primarily removed prior to molding to increase the purity of the char, and then the microparticular or microparticle-type regenerated carbon black can be produced by using the char having the purity as a raw material and then molded into spheres with water serving as a binder, whereby the spherical regenerated carbon black can be produced while reducing the cost and increasing the productivity.

[0078] Further, volatile components of the char obtained through the pyrolysis process of the waste tires can be primarily removed before molding to improve the purity of the char by using the continuous-type pyrolysis furnace, which has a structure capable of performing the continuous operation, and the regenerated carbon black can be produced by using the char as a raw material, and thus, the final regenerated carbon black may have a high quality.

[0079] Next, the description will be made with reference to FIGS. **4** and **5** for explaining a method for the refinement of the char and the manufacture of the regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention.

[0080] FIG. **4** is a flowchart illustrating the method for the refinement of the char and the manufacture of the regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention.

[0081] As shown in the drawings, in step S**110**, the char, which is obtained through pyrolysis of waste tires, may be transferred from the raw material storage tank where the char is stored to the pre-treatment portion to separate foreign substances by sorting the char at least two times.

[0082] For details of step S**110**, referring to FIG. **3**, a primary sorting step is performed in step S**111** so that foreign substances are separated from the char transferred from the raw material storage tank through vibration. Then, a second sorting step is performed in step S**112** so that magnetic materials are separated from the char that has undergone the first sorting step in step S**111** by using magnetic force.

[0083] Returning again to FIG. **4**, in step S**120**, the char is transferred from the pre-treatment portion to the pyrolysis furnace and volatile components of the char are separated by heating the char that moves along first and second chambers, which are installed in the pyrolysis furnace in parallel to each other while being spaced apart from each other in a longitudinal direction and in which both ends of the first and second chambers located in the same direction based on a longitudinal direction are connected to each other;

[0084] In step S**130**, the char is transferred from the pyrolysis furnace to the pulverizing portion to form the regenerated carbon black by pulverizing the char into microparticular or microparticle powder;

[0085] In step S**140**, the regenerated carbon black formed through the pulverizing portion is transferred to the molding portion and is molded into a spherical shape by using water as a binder.

[0086] In step S**150**, the spherical regenerated carbon black molded through the molding portion is transferred to the secondary drying portion so that the spherical regenerated carbon black is dried through a fluidized bed drying method.

[0087] In step S**160**, the spherical regenerated carbon black having a predetermined size or more among the spherical regenerated carbon blacks dried through the secondary drying portion is separated through a vibration screen.

[0088] In step S**170**, the spherical regenerated carbon black that is not separated through the vibration screen is transferred to the packaging portion and packed in a unit of a predetermined amount.

[0089] In addition, in step S**165**, the spherical regenerated carbon black separated through the vibration screen is transferred to a process line where pulverization is performed by the pulverizing portion. Then, the spherical regenerated carbon black transferred in this way is subject to above steps S**130** to S**150** and then goes through step S**160**. When the spherical regenerated carbon black is not separated through the vibration screen in step S**160**, the process goes to step S**170**.

[0090] In this case, above-described steps S**130** and S**140** may include a step of sequentially supplying a predetermined amount of char or regenerated carbon black in a predetermined amount to the pulverizing portion or the molding portion through the quantitative supply device.

[0091] In addition, although not shown in the drawings, the method for refining the char and manufacturing the regenerated carbon black through waste tire pyrolysis according to an embodiment of the present invention may further include a step of periodically removing materials adhering to an inner surface of the gas release pipe of the pyrolysis furnace by using the cylinder and the scraper that reciprocates along the inner surface of the gas release pipe through power of the cylinder.

[0092] As described above, the operation of the method for refining the char and manufacturing the regenerated carbon black through waste tire pyrolysis described with reference to FIGS. **4** and **5** is substantially the same as the method for refining the char and manufacturing the regen-

erated carbon black through waste tire pyrolysis described with reference to FIGS. **1** to **3**, so the detailed description thereof will be omitted.

[0093] As mentioned above, in the present description, specific matters such as specific components and the like have been described with reference to several embodiments and drawings, but they are provided only to help a more comprehensive understanding of the present invention, so the present invention is not limited to the above embodiments, and those skilled in the art to which the present invention pertains can make various modifications and variations from the above description.

[0094] Therefore, the spirit of the present invention is not limited to the described embodiments and it can be understood that not only the claims described below, but also equivalents thereof may fall within the scope of the spirit of the present invention.

What is claimed is:

1. A system for refining char and manufacturing regenerated carbon black through waste tire pyrolysis, the system comprising:

a raw material storage tank in which the char obtained through pyrolysis of waste tires is stored;

a pre-treatment portion for separating foreign substances by sorting at least two times the char transferred from the raw material storage tank;

a pyrolysis furnace for separating volatile components of the char transferred from the pre-treatment portion;

a pulverizing portion for pulverizing the char transferred from the pyrolysis furnace into microparticular or microparticle powder to form regenerated carbon black;

a molding portion for molding the regenerated carbon black transferred from the pulverizing portion into a spherical shape using water as a binder;

a secondary drying portion for drying the spherical regenerated carbon black transferred from the molding portion;

a vibration screen for separating the spherical regenerated carbon black having a predetermined size or more among the spherical regenerated carbon blacks transferred from the secondary drying portion;

a packaging portion for packaging the spherical regenerated carbon blacks transferred from the vibration screen in a unit of a predetermined amount; and

a returning portion for returning the spherical regenerated carbon black separated by the vibration screen to a process line where pulverization is performed through the pulverizing portion,

wherein the pyrolysis furnace comprises:

a housing;

a burner for heating an inside of the housing;

a first chamber horizontally installed inside the housing in a state where one longitudinal end thereof is exposed out of the housing, in which an inlet for the char transferred from the pre-treatment portion is formed at the one longitudinal end exposed out of the housing;

a second chamber disposed inside the housing in parallel to the first chamber, positioned below the first chamber, having one end arranged in a same direction as the one end formed with the inlet of the first chamber and exposed out of the housing in which an outlet for the char is formed at the exposed one end, and having an opposite end which is opposite to the outlet and connected to an opposite end of the first chamber which is opposite to the inlet of the first chamber;

a first transfer portion for transferring the char flowing into the first chamber through the inlet to an opposite side;

a second transfer portion for transferring the char flowing into the second chamber through the first chamber toward the outlet; and

a gas release pipe having one longitudinal end connected to the one end of the first chamber opposite to the inlet to communicate with an inside of the first chamber, and an opposite longitudinal end drawn out of the housing.

2. The system of claim **1**, wherein the pyrolysis furnace further comprises an anti-clogging portion installed in the gas release pipe to remove materials adhering to an inner surface of the gas release pipe by scraping the materials.

3. The system of claim **2**, wherein the gas release pipe is configured in a shape in which a horizontal pipe branches from a central portion of a vertical pipe and a lower end of the vertical pipe is connected to the first chamber, and

the anti-clogging portion includes:

a cylinder which is installed on an upper end of the vertical pipe and disposed such that a front end of a rod reciprocates in a longitudinal direction of the vertical pipe within the vertical pipe; and

a scraper including a hub coupled to the front end of the rod of the cylinder, a ring-shaped portion having a size adapted to make contact with an inner surface of the vertical pipe, and a plurality of ribs, in which both longitudinal ends of the ribs are fixed to the hub and the ring-shaped portion, respectively.

4. The system of claim **1**, wherein the secondary drying portion includes a conveyor belt and is configured to dry the spherical regenerated carbon black transferred along the conveyor belt by applying heat to the spherical regenerated carbon black.

5. A method for refining char and manufacturing regenerated carbon black through waste tire pyrolysis, the method comprising:

transferring the char, which is obtained through pyrolysis of waste tires, from a raw material storage tank where the char is stored to a pre-treatment portion to separate foreign substances by sorting the char at least two times;

transferring the char from the pre-treatment portion to a pyrolysis furnace and separating volatile components of the char by heating the char that moves along first and second chambers, which are installed in the pyrolysis furnace in parallel to each other while being spaced apart from each other in a longitudinal direction and in which both ends of the first and second chambers located in a same direction based on a longitudinal direction are connected to each other;

transferring the char that has passed through the pyrolysis furnace to a pulverizing portion to form regenerated carbon black by pulverizing the char into microparticular or microparticle powder;

transferring the regenerated carbon black formed through the pulverizing portion to a molding portion to form spherical regenerated carbon black using water as a binder;

transferring the spherical regenerated carbon black processed through the molding portion to a secondary drying portion to dry the spherical regenerated carbon black;

separating the spherical regenerated carbon black having a predetermined size or more among the spherical regenerated carbon blacks through a vibration screen after the spherical regenerated carbon black is dried through the secondary drying portion;

transferring the spherical regenerated carbon black, which is not separated through the vibration screen, to a packaging portion to package the spherical regenerated carbon black in a unit of a predetermined amount; and

transferring the spherical regenerated carbon black separated through the vibration screen to a process line where pulverization is performed by the pulverizing portion.

6. The method of claim **5**, further comprising:

periodically removing materials adhering to an inner surface of a gas release pipe of the pyrolysis furnace by using a cylinder and a scraper that reciprocates along the inner surface of the gas release pipe through power of the cylinder.

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