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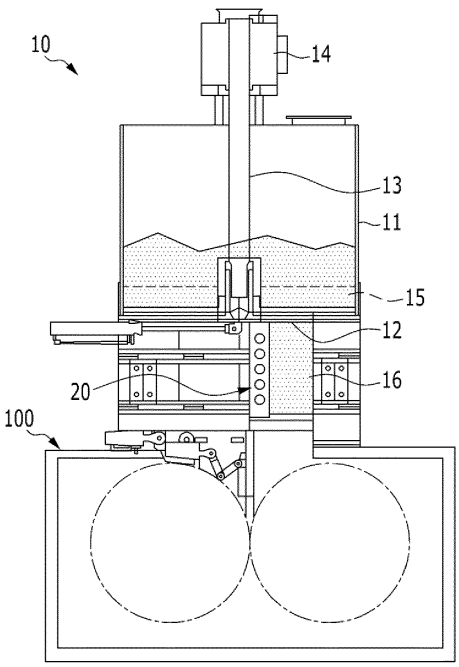
(54) RAW MATERIAL SUPPLY DEVICE AND RAW MATERIAL SUPPLY METHOD FOR COAL BRIQUETTE MANUFACTURING EQUIPMENT

(57) In order to improve the supply flow of the raw materials and to prevent the clogging due to the adherence or aggregation of the raw materials in the supplying apparatus, the present invention provides a raw materials supplying apparatus of a facility for manufacturing coal briquettes installed between a mixer for mixing a powdered coal and a binder to manufacture raw materials and a molding machine for molding the mixed raw materials to manufacture coal briquettes to supply raw materials supplied from a mixer continuously, the apparatus comprising: a feeder main body forming an accommodating space of the raw materials therein and an exit for the raw materials at a lower end; a rotating shaft rotatably installed at the center of the feeder main body; a driving unit installed at the feeder main body and connected to the rotating shaft to rotate the rotating shaft; a blade installed at the rotating shaft to extend in the radial direction; an outlet connected to the exit to extend to the molding machine; and an adjusting unit changing the temperature of the raw materials by applying heat or cold air to the raw materials in the outlet to adjust the viscosity.

FIG. 1



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Description

(a) Field of the Invention

[0001] The present invention relates to an apparatus for manufacturing coal briquettes. More particularly, the present invention relates to a raw material supplying apparatus and a method of supplying raw materials for supplying raw materials to a molding machine of a facility for manufacturing coal briquettes.

(b) Description of the Related Art

[0002] In a direct iron ore smelting reduction process, a reducing furnace for reducing iron ore and a melting furnace for melting the reduced iron ore are used. When the iron ore is melted in the melting furnace, coal briquettes, as a heat source for melting the iron ore, are inputted into the melting furnace. The reduced iron is melted in the melting furnace, converted into molten iron and slag, and then discharged to the outside.

[0003] The coal briquettes should be able to increase the reaction efficiency and the heat transfer efficiency between each material by ensuring the gas permeability and the liquid permeability through which gas and liquid can smoothly pass through the melting and gasifying furnace. For this purpose, after mixing the coal with the appropriate moisture and the binder, the coal briquettes are manufactured in the form of briquettes of a predetermined size by compression-molding the mixed raw materials in the molding machine.

[0004] At the upper portion of the molding machine, a supplying apparatus (gravity feeder) for continuously supplying the raw materials between the rolls of the molding machine is disposed. The supplying apparatus should supply the raw materials uniformly to the molding machine. For this purpose, the amount of raw materials adhered in the supplying apparatus should be small, and it should be ensured that the aggregated raw materials do not grow as it stays and that they are discharged within a proper residence time such that they do not block the exit of the supplying apparatus

[0005] However, in the conventional supplying apparatus, in the process of supplying the raw materials to the molding machine, the moisture and the binder are mixed with each other, and the sticky raw materials are aggregated or adhered to the inside of the supplying apparatus, thereby blocking the passage frequently. As a result, the flowability of the raw materials becomes worse, continuous operation is not performed, and the quality of the coal briquettes is deteriorated.

[0006] Particularly, when a cellulose ether compound such as alkyl cellulose or hydroxyalkyl cellulose, which is easy to use, is used as a binder of the coal briquettes in addition to molasses, the moisture content of the raw materials becomes high because water is added for use of the binder.

[0007] Therefore, the use of the binder having high adhesion and moisture and the powdered coal comprising high moisture simultaneously causes the flow of the raw materials to become worse, and the phenomenon that the raw materials are aggregated or adhered by the binder occurs more frequently.

DETAILED DESCRIPTION OF THE INVENTION

PROBLEM TO SOLVE

[0008] The present invention provides a raw materials supplying apparatus and a method of supplying raw materials of a facility for manufacturing coal briquettes, which is for improving the supply flow of the raw materials and preventing the clogging due to the adherence or aggregation of the raw materials in the supplying apparatus.

[0009] The present invention provides a raw material supplying apparatus and a method of supplying raw materials of a facility for manufacturing coal briquettes, which is for separating the raw materials adhered in the supplying apparatus easily and supplying to the molding machine.

SUMMARY OF THE INVENTION

[0010] The raw materials supplying apparatus of the present embodiment is a raw materials supplying apparatus of a facility for manufacturing coal briquettes installed between a mixer for mixing a powdered coal and a binder to manufacture raw materials and a molding machine for molding the mixed raw materials to manufacture coal briquettes to supply raw materials supplied from a mixer continuously, wherein the apparatus may comprise a feeder main body forming an accommodating space of the raw materials therein and an exit for the raw materials at a lower end; a rotating shaft rotatably installed at the center of the feeder main body; a driving unit installed at the feeder main body and connected to the rotating shaft to rotate the rotating shaft; a blade installed at the rotating shaft to extend in the radial direction; an outlet connected to the exit to extend to the molding machine; and an adjusting unit changing the temperature of the raw materials by applying heat or cold air to the raw materials in the outlet to adjust the viscosity.

[0011] The adjusting unit may comprise at least one housing installed at inner side of the outlet; a supply line connected to the housing to supply high or low temperature fluid to the housing; and a spray nozzle formed at the housing for spraying the fluid to the raw materials in the outlet.

[0012] The supply line may comprise a nitrogen gas line for supplying nitrogen gas for reducing the temperature of the raw materials; a steam line for supplying steam for rising of the temperature of the raw materials; valves installed at the nitrogen gas line and the steam line to open and close each line; and a control unit for controlling and operating each of the valve.

[0013] The housing may have a triangular cross-sec-

tional structure and be a structure which is closely installed at an edge of the outlet.

[0014] The housing may be formed to extend vertically along the outlet and the plurality of spray nozzles may be formed at the housing in the vertical direction at intervals and the spray nozzle formed at the lowest end may be formed within 30 mm from the lower end to the upper portion.

[0015] The binder may be a mixture of cellulose ether.

[0016] The adjusting unit may be a structure which supplies high pressure fluid through the supply line and sprays high pressure fluid through the spray nozzle of the housing to apply impact energy to the raw materials in the outlet.

[0017] The adjusting unit is a structure which supplies the fluid at a pressure of 8 to 16 bar through the supply line.

[0018] The raw materials supplying apparatus of the present embodiment is a raw materials supplying apparatus of a facility for manufacturing coal briquettes installed between a mixer for mixing a powdered coal and a binder to manufacture raw materials and a molding machine for molding the mixed raw materials to manufacture coal briquettes to supply raw materials supplied from a mixer continuously, the apparatus may comprise a feeder main body forming an accommodating space of the raw materials therein and an exit for the raw materials at a lower end; a rotating shaft rotatably installed at the center of the feeder main body; a driving unit installed at the feeder main body and connected to the rotating shaft to rotate the rotating shaft; a blade installed at the rotating shaft to extend in the radial direction; an outlet connected to the exit to extend to the molding machine; and an impact portion installed in the outlet to apply impact energy to raw materials in the outlet.

[0019] The impact unit may comprise at least one housing installed at inner side of the outlet; a supply line connected to the housing to supply high pressure fluid to the housing; and a spray nozzle formed at the housing for spraying the fluid to the raw materials in the outlet.

[0020] The supply line may comprise a nitrogen gas line for supplying high pressure nitrogen gas; and/or a steam line for supplying high pressure steam.

[0021] The housing may have a triangular cross-sectional structure and be a structure which is closely installed at an edge of the outlet.

[0022] The housing may be formed to extend vertically along the outlet and the plurality of spray nozzles may be formed at the housing in the vertical direction at intervals and the spray nozzle formed at the lowest end may be formed within 30 mm from the lower end to the upper portion.

[0023] The impact unit may be a structure which supplies the fluid at a pressure of 8 to 16 bar through the supply line.

[0024] The method of supplying raw materials of the present embodiment may comprise a mixing step mixing a powdered coal and a binder in a mixer; a supplying step supplying the mixed raw materials to a molding machine through a supplying apparatus; and a molding step compressing the raw materials with the molding machine to manufacture coal briquettes, wherein the supplying step may comprise an adjusting step changing the temperature of the raw materials by applying heat or cold air to the raw materials to adjust the viscosity.

[0025] The adjusting step may comprise the step of spraying steam and/or a nitrogen gas to the raw materials.

[0026] The binder may be a mixture of cellulose ether.

[0027] The adjusting step may heat the raw materials to a temperature from room temperature up to not higher than the gel point generating temperature.

[0028] The supplying step may further comprise an impacting step applying impact energy to the raw materials.

[0029] The impacting step may be a structure which sprays high pressure fluid to impact the raw materials.

[0030] The fluid may be a nitrogen gas and/or steam.

[0031] The pressure of the fluid may be 8 to 16 bar.

[0032] The method of supplying raw materials of the present embodiment may comprise mixing a powdered coal and a binder in a mixer; supplying the mixed raw materials to a molding machine through a supplying apparatus; and compressing the raw materials with the molding machine to manufacture coal briquettes, wherein the step of supplying the mixed raw materials to a molding machine through a supplying apparatus comprises applying impact energy to the raw materials.

[0033] The step of applying impact energy may be a structure which sprays high pressure fluid to impact the raw materials.

[0034] The fluid may be a nitrogen gas and/or steam.

[0035] The pressure of the fluid may be 8 to 16 bar.

EFFECTS OF THE INVENTION

[0036] According to the present embodiment as described above, by controlling the temperature of the raw materials by spraying low temperature nitrogen gas and high temperature steam in the process of supplying the raw materials, the viscosity of the binder is appropriately maintained so that it is possible to minimize the adherence of the raw materials inside the raw materials supplying apparatus.

[0037] It is possible to prevent the adherence of the raw materials to the angled corners of the outlet to which the raw materials are supplied.

[0038] By spraying high pressure fluid to the raw materials and applying the impact energy, it is possible to separate the raw materials adhered or aggregated inside the raw materials supplying apparatus easily.

[0039] It is possible to supply the raw materials uniformly to the molding machine by preventing the adherence or clogging by segregation of the raw materials in the raw materials supplying apparatus and improving the flowability of the raw materials.

DESCRIPTION OF THE DRAWINGS

[0040]

FIG. 1 is a schematic side cross-sectional view showing a raw materials supplying apparatus of the facility for manufacturing coal briquettes according to the present embodiment.

FIG. 2 is a schematic plan sectional view showing a raw materials supplying apparatus of the facility for manufacturing coal briquettes according to the present embodiment.

FIG. 3 is a schematic view showing the housing provided inside the raw materials supplying apparatus according to the present embodiment.

FIG. 4 is a flowchart schematically showing a raw materials supplying process according to the present embodiment.

FIG. 5 is a graph for explaining the viscosity of the binder by the temperature of the raw materials according to the present embodiment.

FIG. 6 is a graph showing supply flow of the raw materials according to the present embodiment in comparison with a conventional one.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0041] The technical terms used herein are used merely for the purpose of describing a specific exemplary embodiment, and not intended to limit the present invention. Singular expressions used herein include plural expressions unless they have definitely opposite meanings. The terms "comprises" and/or "comprising" used in the specification specify particular features, regions, integers, steps, operations, elements, components, but do not preclude the presence or addition of other features, regions, integers, steps, operations, elements, and/or components thereof.

[0042] The present invention will be described hereinafter with reference to the accompanying drawings so that those skilled in the art may easily carry out the present invention, in which exemplary embodiments of the invention are shown. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. Accordingly, the present invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

[0043] FIG. 1 schematically shows a raw materials supplying apparatus of a facility for manufacturing coal briquettes according to the present embodiment.

[0044] The raw materials supplying apparatus of the facility for manufacturing coal briquettes of FIG. 1 is merely for illustrating the present invention, and the present invention is not limited thereto. Therefore, it is possible to variously modify the structure of the raw materials supplying apparatus of the facility for manufacturing coal briquettes.

[0045] As shown in FIG. 1, a facility for manufacturing coal briquettes comprises a supplying apparatus 10 which is installed between a mixer (not shown) for mixing a powdered coal with a binder and a molding machine 100 for producing briquettes by compression-molding the mixed raw materials and supply the raw materials from the mixer to the molding machine.

[0046] The facility for manufacturing coal briquettes may further comprise other apparatus, such as at least one kneader connected to the downstream end of the mixer for kneading the raw materials, and a transport screw for transporting the raw materials discharged from the kneader, as necessary.

[0047] In the present embodiment, the supplying apparatus 10 comprises a feeder main body 11 forming an accommodating space of the raw materials therein and an exit 12 for the raw materials at a lower end; a rotating shaft 13 rotatably installed at the center of the feeder main body 11; a driving unit 14 installed at the upper portion of the feeder main body and connected to the rotating shaft to rotate the rotating shaft; a blade 15 installed at the rotating shaft; an outlet 16 connected to the exit 12 and extending to the molding machine to discharge the raw materials. The blade 15 has an elongated bar-shaped structure, one end of which is installed at the rotating shaft and the other end of which extends in the radial direction of the rotating shaft toward the inner circumferential surface of the feeder main body. When the rotating shaft is rotated, the blade 15 provided on the rotating shaft 13 is rotated around the rotating shaft so that the raw materials stored in the feeder main body 11 are discharged through the exit 12 at the lower end of the feeder main body and supplied to the molding machine 100 through the outlet 16.

[0048] As shown in FIG. 1 and FIG. 2, the outlet 16 has an upper end connected to the bottom exit 12 of the cylindrical feeder main body and a lower end extending in the vertical direction toward the molding machine 100 to form a channel through which the raw materials pass through. The outlet 16 has a rectangular cross-sectional structure as shown in FIG. 2. The outlet 16 is a narrow channel through which the raw materials pass through, and is a portion where clogging mainly occurs due to adhesiveness of the binder mixed in the raw materials.

[0049] The raw materials supplying apparatus of the present embodiment is provided with an adjusting unit for changing the temperature of the raw materials by applying heat or cold air to the raw materials in the outlet 16. The adjusting unit adjusts the viscosity of the binder mixed with the raw materials to improve the flowability of the raw materials by changing the temperature of the raw materials.

[0050] The binder mixed with water has a viscosity property that when the temperature exceeds a certain temperature, the adhesive strength is rapidly decreased and the viscosity becomes too high below a certain temperature. In the present embodiment, the viscosity of the

binder is appropriately controlled by adjusting the temperature of the raw materials by using the viscosity property of the binder, so that the raw materials may smoothly flow without being adhered to the inside of the outlet 16.

[0051] As shown in FIG. 2 and Fig 3, the adjusting unit may comprise at least one housing 20 installed at inner side of the outlet 16; a supply line connected to the housing 20 to supply high or low temperature fluid to the housing 20; and a spray nozzle 22 formed at the housing 20 for spraying the fluid to the raw materials in the outlet 16.

[0052] The supply line comprises a nitrogen gas line 30 for supplying nitrogen gas for reducing the temperature of the raw materials; a steam line 32 for supplying steam for rising of the temperature of the raw materials; valves 31, 33 installed at the nitrogen gas line 30 and the steam line 32 to open and close each line; and a control unit 34 for controlling and operating each of the valve.

[0053] Accordingly, by controlling the temperature of the raw materials by spraying high temperature steam or low temperature nitrogen gas to the raw material supplied through the outlet 16, the viscosity of the raw materials may be varied, and the flowability of the raw materials may be appropriately controlled.

[0054] As shown in FIG. 2, the nitrogen gas line 30 is connected to the housing 20 to supply low temperature nitrogen gas, and the steam line 32 is also connected to the housing 20 to supply high temperature steam.

[0055] The valves 31 and 33 are installed in the nitrogen gas line 30 and the steam line 32 respectively, and the valves 31 and 33 are connected to the control unit 34 and driven according to a signal of the control unit 34 to open and close the respective lines. In the present embodiment, the nitrogen gas line 30 and the steam line 32 may be connected to the respective housings 20 through a common line 35.

[0056] The control unit 34 drives and controls the valves 31 and 33 according to the temperature of the raw materials in the outlet 16. The temperature of the raw material in the outlet 16 may be detected, for example, through a temperature sensor (not shown) installed inside the outlet 16.

[0057] The steam supplied through the steam line 32 is sprayed to the raw materials through the spray nozzle 22 formed in the housing 20 to increase the temperature of the raw materials. In contrast, the nitrogen gas supplied through the nitrogen gas line 30 is sprayed to the raw materials through the spray nozzle 22 formed in the housing 20 to decrease the temperature of the raw materials.

[0058] By adjusting the temperature of the raw materials, the viscosity of the binder mixed in the raw materials is changed, and the flowability of the raw materials in the outlet 16 is improved.

[0059] In the present embodiment, the housing 20 is formed to have a length corresponding to the vertical length of the outlet 16 and is installed in the vertical direction at the inner side of the outlet 16. The housing 20 may be installed at an edge of the outlet 16. The housing 20 may be installed respectively at every inner edge of the outlet 16 or may be installed only at an appropriate location where it can be installed, as shown in FIG. 2. The installed location of the housing 20 and the number of the housing 20 may be variously set and are not particularly limited.

[0060] The outlet 16 may be a tubular structure having a rectangular cross-sectional structure as described above, and the housing 20 may have a triangular cross-sectional structure corresponding to the shape of the inner edge of the outlet 16. Thus, the housing 20 is exactly installed closely at an edge of the outlet 16.

[0061] Accordingly, the housing 20 is provided at the edge of the outlet 16 to block the edge, thereby preventing the raw materials from stagnating at the edge portion of the outlet 16. Since the edge of the outlet 16 is bent perpendicularly so that the raw materials tend to be easily stagnated at that portion, the stagnation of the raw materials may be fundamentally prevented at the edge portions by being blocked by the housing 20.

[0062] The housing 20 is formed to extend vertically along the outlet 16, as shown in FIG. 3. The housing 20 has a hollow structure with a hollow inside and a supply port 24 through which fluid is supplied to the inside is formed at one side of the housing 20 and a plurality of spray nozzles 22 are formed on the front surface, that is, the surface facing the inside of the outlet 16. The supply port 24 is connected to the common line 35. The plurality of spray nozzles are formed at the housing in the vertical direction at intervals. The fluid introduced into the housing 20 through the supply port 24 is sprayed to the inside of the outlet 16 through the plurality of spray nozzles 22 formed in the housing 20. The sizes and the forming intervals of the spray nozzles 22 can be variously set according to specifications of the facility.

[0063] In the present embodiment, the spray nozzle 22 located at the lowest one of the spray nozzles 22 formed in the housing 20 is formed in a range D within 30 mm from the lower end to the upper portion so as to easily discharge the raw materials penetrated into the housing 20.

[0064] Thus, the raw materials introduced into the housing 20 is easily discharged to the outside of the housing 20 through the spray nozzle 22 at the lowest end. That is, in the process of supplying the raw materials through the outlet 16, the raw materials introduced into the housing 20 through the spray nozzle 22 fall to the lower end of the housing 20 by their own weight. The spray nozzle 22 at the lowest end formed in the housing 20 is formed in the range D so as to be close to the lower end of the housing 20 so that the raw materials introduced into the housing 20 may be easily discharged through the lowermost spray nozzle 22. When the location of the spray nozzle 22 at the lowest end among the spray nozzles 22 is out of the range D, the location of the spray nozzle 22 at the lower end of the housing 20 is too high so that a problem that the raw materials which are introduced into the housing 20 and fall downward cannot exit through the spray nozzle 22 occurs.

[0065] Here, when the raw materials passing through the outlet 16 are aggregated and adhered to the inside of the outlet 16, the supplying apparatus 10 of the present embodiment improves the flowability of the raw materials by applying a physical impact to the raw materials and separating the raw materials.

[0066] For this purpose, the supplying apparatus 10 may have an impact unit for applying physical impact energy to the raw material. In case of this embodiment, the impact unit may be a physical impact energy for the raw materials and be a structure which uses the spraying pressure of nitrogen gas or steam supplied into the outlet 16 as described above. The impact unit may apply a physical impact to the raw materials as a separate energy other than the spraying pressure of the nitrogen gas or steam.

[0067] The supplying apparatus may be a structure which sprays high pressure nitrogen gas and steam through the spray nozzle 22 of the housing 20 to apply physical impact energy to the raw materials.

[0068] In this embodiment, the nitrogen gas may be supplied through the nitrogen gas line 30 at a pressure of 8 to 16 bar. More preferably, the nitrogen gas may be supplied at a pressure of 8 to 14 bar. In addition, the steam may be supplied through the steam line 32 at a pressure of 8 to 16 bar. More preferably, the steam may be supplied at a pressure of 10 to 16 bar.

[0069] When the pressure of the fluid such as nitrogen gas or steam is lower than the above range, the impact energy due to the fluid is too weak to obtain the separation effect of the raw materials and when being higher than the above range, there is a problem that the cost according to high pressure rises while increasing of the effect of discharge of the raw materials is not great.

[0070] Like this, nitrogen gas or steam supplied at a high pressure is sprayed to the raw materials at high pressure through the spray nozzle 22 of the housing 20. The pressure of the fluid sprayed through the spray nozzle 22 acts on the raw materials as impact energy.

[0071] Thus, the raw materials are separated from the inner side of the outlet 16 by the impact applied by the fluid, and the raw materials that have not been smoothly flowed down by segregation is pushed and discharged by the impact energy of the fluid.

[0072] Hereinafter, the raw materials supply process through the raw materials supplying apparatus of the present embodiment will be described with reference to FIG. 4.

[0073] The raw materials mixed the powdered coal and the binder are supplied to the molding machine through the supplying apparatus after the mixing process, and are compressed at the molding machine to manufacture coal briquettes. In the process of supplying the raw materials to the molding machine, the viscosity of the binder mixed with the raw materials may be controlled or the raw materials may be impacted to improve the flowability thereof.

[0074] In this embodiment, the binder mixed with the raw materials may comprise a mixture of cellulose ethers such as alkylcellulose and hydroxyalkylcellulose. When the cellulose ether mixture is comprised as a binder, the process of adding water to the mixture of the binder and the raw materials and mixing may be subjected. The raw materials mixed in the form of dough are supplied to the molding machine through the raw materials supplying process by the supplying apparatus.

[0075] According to this embodiment, in order to smoothly and uniformly supply the raw materials in the raw materials supplying process, the adjusting step changing the temperature of the raw materials by applying heat or cold air to the raw materials to adjust the viscosity is subjected.

[0076] The adjusting step may change the temperature of the raw materials and adjust the viscosity by spraying high temperature steam and/or low temperature nitrogen gas to the raw materials. The high temperature steam acts to increase the temperature of the raw materials, and the low temperature nitrogen gas acts to decrease the temperature of the raw materials.

[0077] FIG. 5 shows the viscosity properties according to the temperature by the concentration of the cellulose ether mixture used as a binder in this embodiment. The binder has the viscosity properties that the viscosity is decreased as the temperature becomes low, and the viscosity of the binder becomes low rapidly in the gel point generating temperature region, which is a specific temperature. The gel point may mean the temperature at which the viscosity becomes rapidly weaker and becomes gel.

[0078] As shown in FIG. 5, in the case of the cellulose ether mixture, it may be confirmed that the viscosity becomes low when the temperature rises regardless of the concentration of the binder, and the viscosity is rapidly decreased at a specific temperature range of 80 to 85 °C, which is the gel point generating temperature.

[0079] When the raw materials are heated or cooled until before the gel point generation according to this viscosity property of the binder, the viscosity of the raw materials becomes low or high, it is possible to prevent the adherence of the raw materials in the outlet 16 of the supplying apparatus and to improve the flowability thereof while minimizing deterioration of quality of coal briquettes.

[0080] That is, to increase the temperature of the raw materials by supplying high temperature steam to the raw materials or to decrease the temperature of the raw materials by spraying low temperature nitrogen gas in the adjusting process.

[0081] When the temperature of the raw materials in the outlet 16 is low and the viscosity is high, the control unit 34 operates to open the valve of the steam line 32 to supply high temperature steam into the outlet 16. The high temperature is a temperature higher than the present temperature of the raw materials and may refer to a temperature at which the viscosity may be decreased to a desired level according to the viscosity property of

the binder, for example, until before the gel point generating temperature. Like this, the temperature of the raw materials becomes high by spraying high temperature steam to the raw material. As a result, the temperature of the binder mixed in the raw materials becomes high and the viscosity becomes low. As the viscosity decreases, the flowability of the raw materials is improved and a smooth supply is achieved.

[0082] In the case of this embodiment, steam may be applied according to the viscosity property of the binder to heat the raw materials to a temperature before the gel point generation from room temperature. As shown in Fig. 5, in the case of the binder being a cellulose ether mixture, the gel point generating temperature is approximately 80 to 85 °C. The viscosity of the cellulose ether mixture as a binder in the gel point generating temperature region becomes low rapidly, so that the viscosity of the raw materials is deteriorated. When the temperature of the raw materials becomes high up to the gel point generating temperature, the viscosity of the raw materials is rapidly decreased, so that the quality of coal briquettes is deteriorated in the subsequent molding process. In addition, the flowability is not improved because the viscosity of the raw materials is high at a temperature lower than room temperature. Therefore, by increasing temperature of the raw materials to lower than the gel point generating temperature at room temperature in accordance with the viscosity property according to the temperature of the binder, the flowability of the raw materials may be improved without deteriorating the quality of coal briquettes.

[0083] In the process of improving the flowability of the raw material, when after the flowability of the raw materials is improved due to high temperature steam spraying or when the temperature of the raw materials becomes too high, the control unit 34 operates to open the valve of the nitrogen gas line 30 to supply low temperature nitrogen gas is supplied into the outlet 16. The low temperature is a temperature lower than the present temperature of the raw materials and preferably may refer to a temperature lower than the range of the gel point temperature of the binder.

[0084] By spraying low temperature nitrogen gas to the raw material, the temperature of the raw materials becomes low. Thus, the temperature of the binder mixed in the raw materials becomes low, so that the viscosity may be recovered, and the quality of the coal briquettes may be ensured.

[0085] Like this, the viscosity of the binder in the raw materials is adjusted by adjusting the temperature of the raw materials by spraying high temperature steam and low temperature nitrogen gas to the raw materials through the adjusting process. Therefore, when the flow of the raw materials through the outlet 16 is deteriorated, the flowability of the raw materials may be improved by decreasing the viscosity of the raw materials.

[0086] Thus, the viscosity of the binder may be appropriately adjusted in accordance with the temperature so that the flowability of the raw materials is improved and may prevent the raw materials from stagnating, so that the raw materials are supplied more smoothly.

[0087] In addition, when the raw materials are already adhered or aggregated to the inner surface of the outlet 16 and is difficult to be discharged in the process of supplying the raw materials, the raw materials may be separated and discharged by applying impact energy to the raw materials.

[0088] In this embodiment, the process of applying the impact energy to the raw materials may be performed by spraying high temperature steam or nitrogen gas to the raw material. That is, steam or nitrogen gas sprayed for adjusting the temperature of the raw materials in the outlet 16 applies an impact to the raw material, and the raw materials are removed from the inner surface of the outlet 16 and are dropped off.

[0089] In the process of applying the impact energy to the raw material, high pressure steam or nitrogen gas may be repeatedly supplied and interrupted according to the set time. As the high pressure fluid spraying is repeatedly performed, the impact energy is repeatedly applied to the raw material, so that the separation of the raw materials and the efficiency of discharging the aggregated raw materials may be increased.

Experiment

[0090] FIG. 6 shows a result of a comparative experiment of the raw materials supply flow of the present embodiment and conventional one.

[0091] In FIG. 6, the present embodiment shows the raw materials supply flow results when the raw materials are supplied while the steam and nitrogen gas are sprayed into the outlet 16 of the supplying apparatus according to the present invention to produce coal briquettes. The comparative embodiment shows the raw materials supply flow results when producing coal briquettes under the conventional raw materials supply without steam and nitrogen gas spraying process.

[0092] In the present embodiment and comparative embodiment, the supply flow of the raw materials was measured at the production of 40 t/h of the actual coal briquettes, and the cellulose binder was used as the binder to be mixed into the raw material, and the experiment was conducted at the condition with high moisture content of 11 wt% based on mixture.

[0093] The experimental results as shown in FIG. 6, in case of comparative embodiment, 4 times of the raw materials clogging occurred for 4 hours, but in case of the embodiment, only one clogging occurred for 8 hours.

[0094] As described above, in case of the present embodiment, by spraying high pressure nitrogen gas or steam into the outlet 16, it is possible to prevent the raw materials from the clogging in the supplying apparatus and to improve the flowability of the raw material.

[0095] While this invention has been described in connection with what is presently considered to be practical

exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

1. A raw materials supplying apparatus of a facility for manufacturing coal briquettes installed between a mixer for mixing a powdered coal and a binder to manufacture raw materials and a molding machine for molding the mixed raw materials to manufacture coal briquettes to supply raw materials supplied from a mixer continuously, the apparatus comprising:
a feeder main body forming an accommodating space of the raw materials therein and an exit for the raw materials at a lower end; a rotating shaft rotatably installed at the center of the feeder main body; a driving unit installed at the feeder main body and connected to the rotating shaft to rotate the rotating shaft; a blade installed at the rotating shaft to extend in the radial direction; an outlet connected to the exit to extend to the molding machine; and an adjusting unit changing the temperature of the raw materials by applying heat or cold air to the raw materials in the outlet to adjust the viscosity.

2. The apparatus of claim 1, wherein
the adjusting unit comprises at least one housing installed at inner side of the outlet; a supply line connected to the housing to supply high or low temperature fluid to the housing; and a spray nozzle formed at the housing for spraying the fluid to the raw materials in the outlet.

3. The apparatus of claim 2, wherein
the supply line comprises a nitrogen gas line for supplying nitrogen gas for reducing the temperature of the raw materials; a steam line for supplying steam for rising of the temperature of the raw materials; Valves installed at the nitrogen gas line and the steam line to open and close each line; and a control unit for controlling and operating each of the valve.

4. The apparatus of claim 3, wherein
the housing has a triangular cross-sectional structure and is a structure which is closely installed at an edge of the outlet.

5. The apparatus of claim 3, wherein
the housing is formed to extend vertically along the outlet and the plurality of spray nozzles are formed at the housing in the vertical direction at intervals and the spray nozzle formed at the lowest end is formed within 30 mm from the lower end to the upper portion.

6. The apparatus of any of claims 1 to 5, wherein
the adjusting unit is a structure which supplies high pressure fluid through the supply line and sprays high pressure fluid through the spray nozzle of the housing to apply impact energy to the raw materials in the outlet.

7. The apparatus of claim 6, wherein
the adjusting unit is a structure which supplies the fluid at a pressure of 8 to 16 bar through the supply line.

8. A raw materials supplying apparatus of a facility for manufacturing coal briquettes installed between a mixer for mixing a powdered coal and a binder to manufacture raw materials and a molding machine for molding the mixed raw materials to manufacture coal briquettes to supply raw materials supplied from a mixer continuously, the apparatus comprising:
a feeder main body forming an accommodating space of the raw materials therein and an exit for the raw materials at a lower end; a rotating shaft rotatably installed at the center of the feeder main body; a driving unit installed at the upper portion of the feeder main body and connected to the rotating shaft to rotate the rotating shaft; a blade installed at the rotating shaft to extend in the radial direction; an outlet connected to the exit to extend to the molding machine; and an impact portion installed in the outlet to apply impact energy to raw materials in the outlet.

9. The apparatus of claim 8, wherein
the impact unit comprises at least one housing installed at inner side of the outlet; a supply line connected to the housing to supply high pressure fluid to the housing; and a spray nozzle formed at the housing for spraying the fluid to the raw materials in the outlet.

10. The apparatus of claim 9, wherein
the supply line comprises a nitrogen gas line for supplying high pressure nitrogen gas; and/or a steam line for supplying high pressure steam.

11. The apparatus of claim 10, wherein
the housing has a triangular cross-sectional structure and is a structure which is closely installed at an edge of the outlet.

12. The apparatus of claim 10, wherein
the housing is formed to extend vertically along the outlet and the plurality of spray nozzles are formed at the housing in the vertical direction at intervals and the spray nozzle formed at the lowest end is formed within 30 mm from the lower end to the upper portion.

13. The apparatus of claim 10, wherein

the impact unit is a structure which supplies the fluid at a pressure of 8 to 16 bar through the supply line.

14. A method of supplying raw materials of a facility for manufacturing coal briquettes comprising:

a mixing step mixing a powdered coal and a binder in a mixer; a supplying step supplying the mixed raw materials to a molding machine through a supplying apparatus; and a molding step compressing the raw materials with the molding machine to manufacture coal briquettes,
wherein the supplying step comprises an adjusting step changing the temperature of the raw materials by applying heat or cold air to the raw materials to adjust the viscosity.

15. The method of claim 14, wherein
the adjusting step comprises the step of spraying steam and/or a nitrogen gas to the raw materials.

16. The method of claim 15, wherein
the binder is a mixture of cellulose ether, and the adjusting step is heating at a temperature from room temperature up to not higher than the gel point generating temperature of the binder by spraying steam to the raw materials.

17. The method of any of claims 14 to 16, wherein
the supplying step further comprises an impacting step applying impact energy to the raw materials.

18. The method of claim 17, wherein
the impacting step is a structure which sprays high pressure fluid to impact the raw materials.

19. The method of claim 18, wherein
the fluid is a nitrogen gas and/or steam.

20. The method of claim 19, wherein
the pressure of the fluid is 8 to 16 bar.

21. A method of supplying raw materials of a facility for manufacturing coal briquettes comprising:

mixing a powdered coal and a binder in a mixer; supplying the mixed raw materials to a molding machine through a supplying apparatus; and compressing the raw materials with the molding machine to manufacture coal briquettes,
wherein the step of supplying the mixed raw materials to a molding machine through a supplying apparatus comprises applying impact energy to the raw materials.

22. The method of claim 21, wherein
the step of applying impact energy is a structure which sprays high pressure fluid to impact the raw materials.

23. The method of claim 22, wherein
the fluid is a nitrogen gas and/or steam.

24. The method of claim 23, wherein
the pressure of the fluid is 8 to 16 bar.

FIG. 1

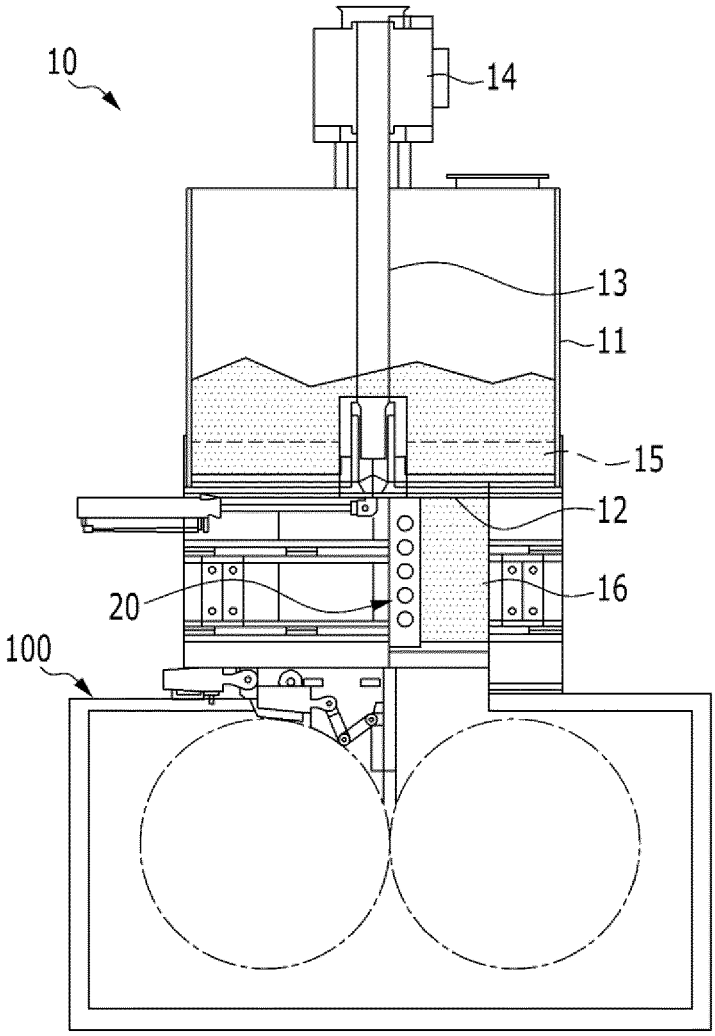


FIG. 2

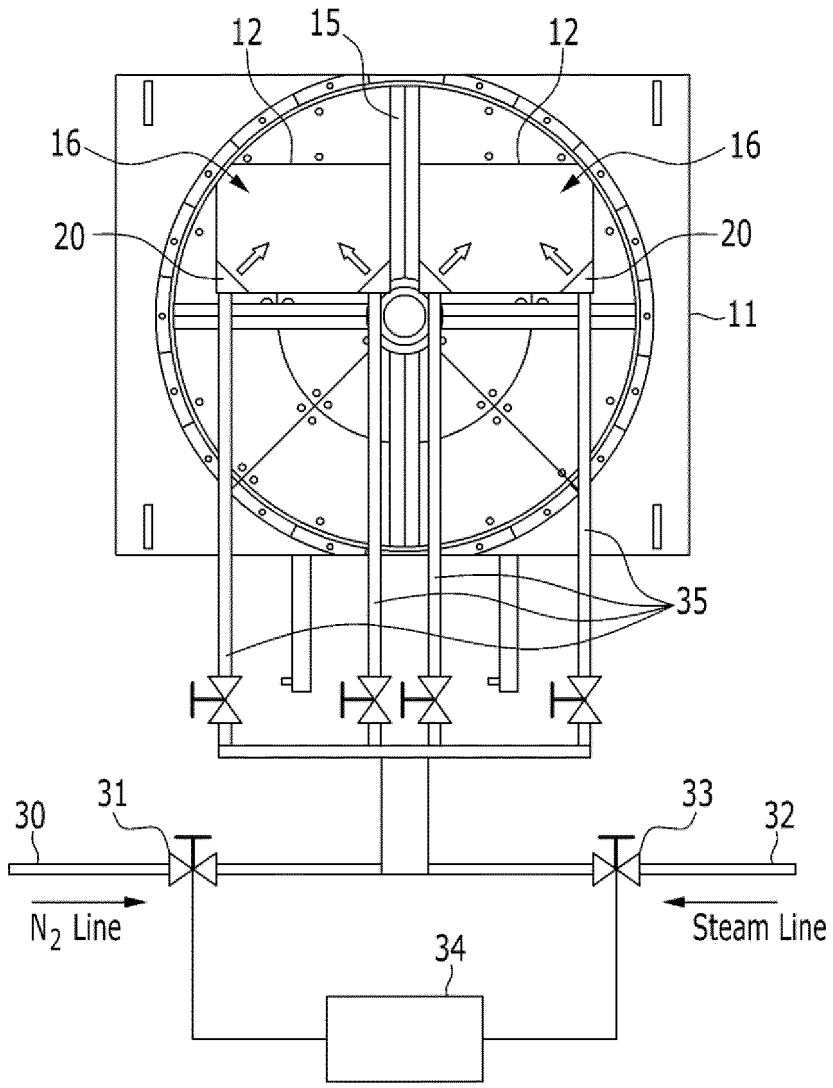


FIG. 3

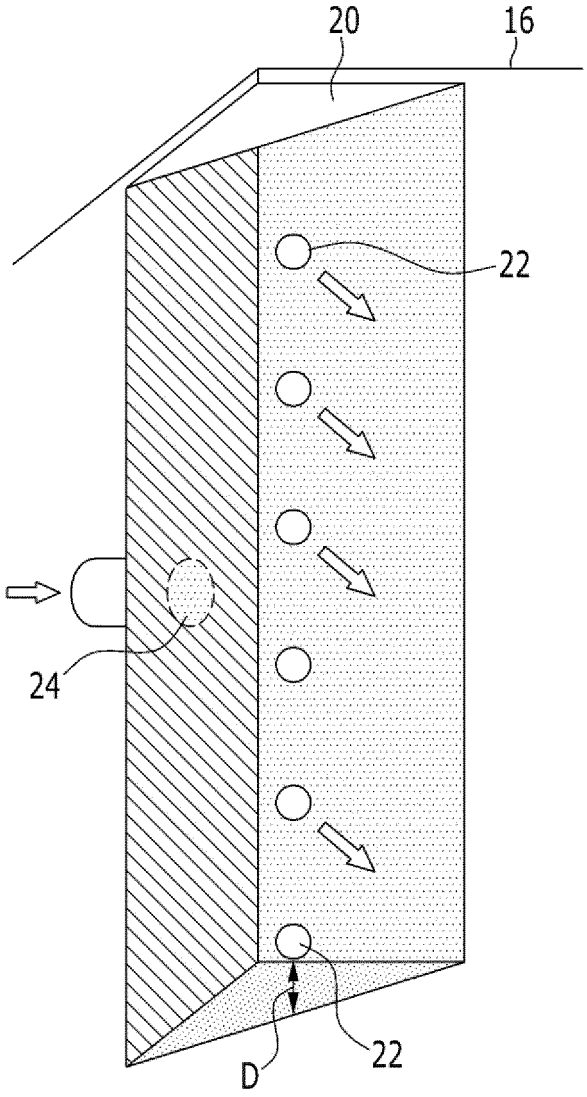


FIG. 4

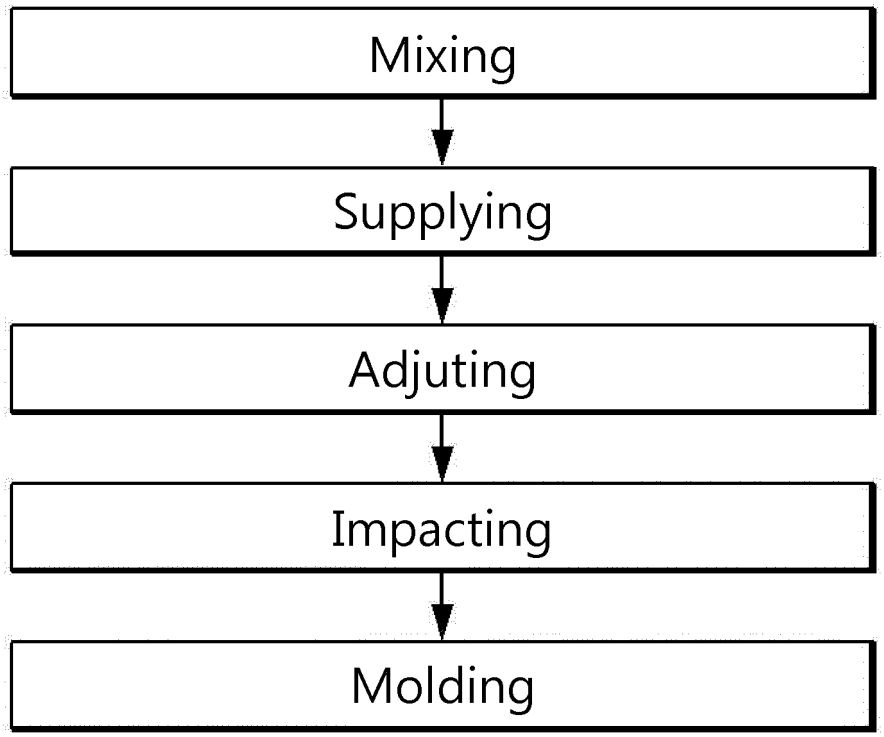
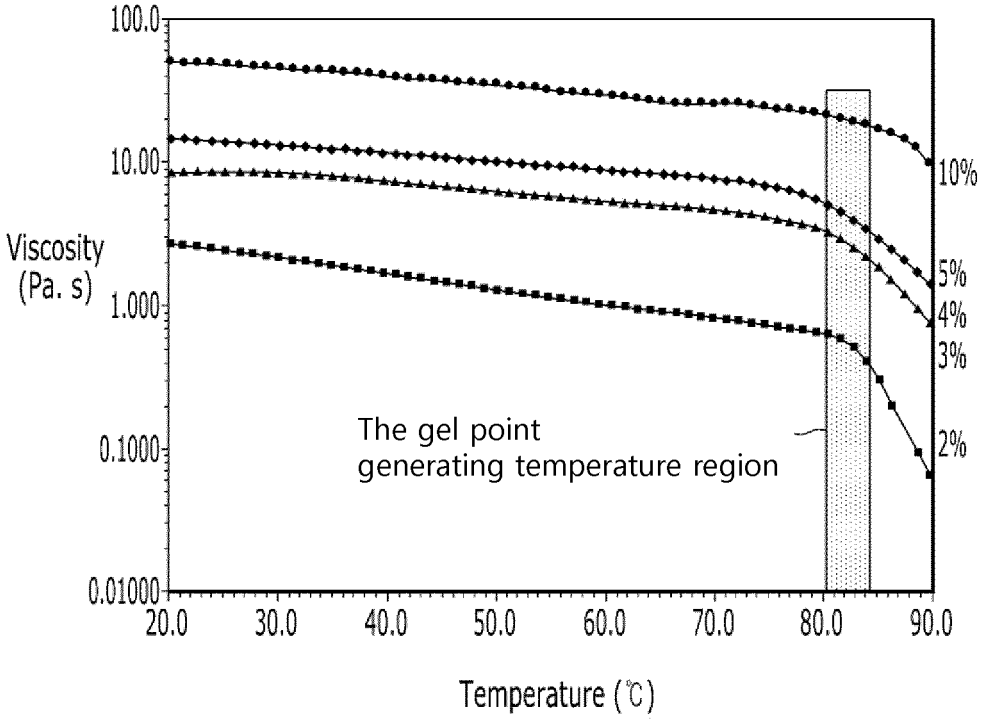


FIG. 5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1.000
0.1000
0.01000
Viscosity
(Pa. s)
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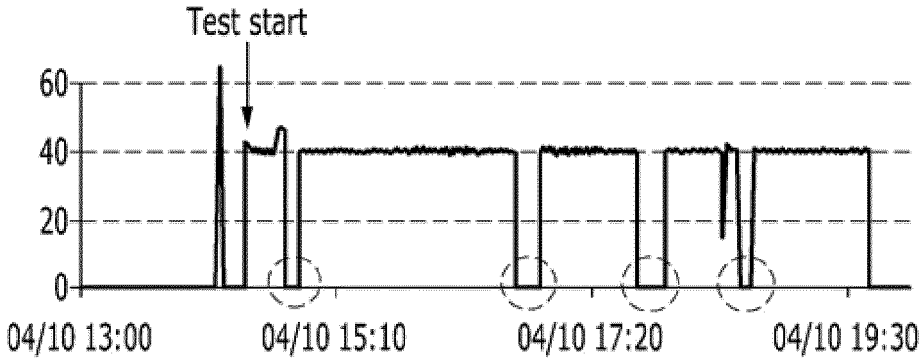
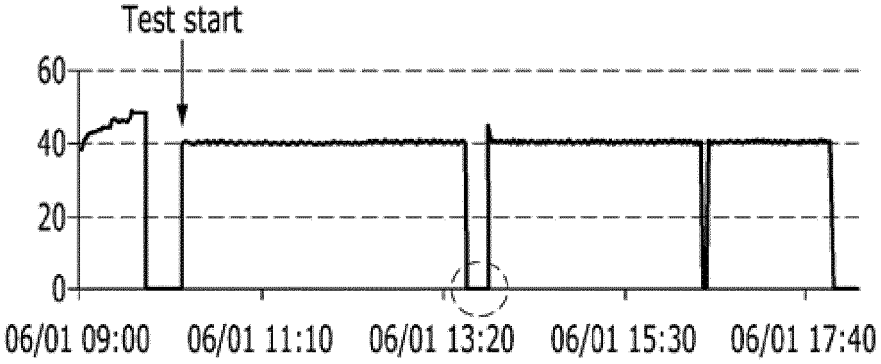
30.0
40.0
50.0
60.0
70.0
80.0
90.0
Temperature (℃)
The gel point
generating temperature region
10%
5%
4%
3%
2%

FIG. 6



<Comparative Example>



<Example>

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2017/006683

A. CLASSIFICATION OF SUBJECT MATTER

C10B 31/00(2006.01)i, C10L 5/10(2006.01)i, C10L 5/36(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)

C10B 31/00; C10B 45/02; C10L 5/00; B30B 11/22; B30B 11/00; C10L 9/10; C10L 5/08; B01F 15/02; C10L 5/10; C10L 5/04; C10L 5/36

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: coal briquette, manufacturing, fine coal, binder, mixing, base material, supplying, temperature, impact, feeder

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2016-0075264 A (POSCO) 29 June 2016 See abstract; paragraph [0024]; claim 1; and figures 1 and 2.	1,8,14,21
A		2-7,9-13,15,16,22-24
Y	KR 10-0332913 B1 (POSCO) 18 July 2002 See claims 1 and 2.	1,14
Y	KR 10-2012-0008588 A (JINIL PLANT ENGINEERING CO., LTD. et al.) 01 February 2012 See claims 1 and 5.	8,21
A	KR 10-2013-0097919 A (KOTECHENGINEERING CO., LTD.) 04 September 2013 See paragraphs [0036]-[0042]; and figure 1.	1-16,21-24
A	JP 2014-214201 A (KOBE STEEL LTD.) 17 November 2014 See paragraphs [0023]-[0037]; and figure 2.	1-16,21-24

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 SEPTEMBER 2017 (25.09.2017)	**26 SEPTEMBER 2017 (26.09.2017)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. +82-42-481-8578	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2017/006683

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: **18-20**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 18-20 refer to a claim not drafted in an alternative format according to PCT Rule 6.4(a), and thus claims 18-20 are unclear under PCT Article 6.

3. ☒ Claims Nos.: **17**
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2017/006683

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2016-0075264 A	29/06/2016	KR 10-1674888 B1	10/11/2016
KR 10-0332913 B1	18/07/2002	KR 10-1999-0052234 A	05/07/1999
KR 10-2012-0008588 A	01/02/2012	NONE	
KR 10-2013-0097919 A	04/09/2013	NONE	
JP 2014-214201 A	17/11/2014	AU 2014-258729 A1	01/10/2015
		AU 2014-258729 B2	24/03/2016
		CN 105121608 A	02/12/2015
		EP 2990467 A1	02/03/2016
		JP 5985433 B2	06/09/2016
		US 2015-0376529 A1	31/12/2015
		US 9738844 B2	22/08/2017
		WO 2014-174985 A1	30/10/2014

Form PCT/ISA/210 (patent family annex) (January 2015)