[DESCRIPTION]

[TITLE OF INVENTION]

WASTE COMBUSTION DEVICE AND WASTE COMBUSTION METHOD

[Technical Field]

[0001]

The present disclosure relates to a waste combustion device and a waste combustion method.

Priority is claimed on Japanese Patent Application No. 2019-192672, filed on October 23, 2019, the content of which is incorporated herein by reference.

[Background Art]

[0002]

A waste combustion device such as a waste incinerator generally combusts s solid fuel such as waste and biomass charged into a hopper in a combustion chamber. However, solid fuels such as waste and biomass have a characteristic of large fluctuation in fuel properties, and there is a problem that when the properties of waste to be charged change, a combustion state also changes. Therefore, a waste treatment device is required to stabilize combustion.

[0003]

For example, in Patent Document 1, when a bulk density of waste charged into the hopper is calculated, and the amount of change from a previous bulk density exceeds a predetermined threshold value, a method of controlling combustion according to the amount of change in the quality of waste by correcting a calorific value reference value based on the amount of change in bulk density is disclosed.

[Citation List]

[Patent Document]

[0004]

[Patent Document 1]

Japanese Patent No. 6153090

[Summary of Invention]

[Technical Problem]

[0005]

However, as in the method described in Patent Document 1, when the change in the quality of waste is determined based on the amount of change in the bulk density obtained from the entire waste in the hopper, there still remains a problem that it is not possible to respond to changes in the properties of waste immediately before being charged into a combustion chamber and to perform stable combustion control.

[0006]

Therefore, in several embodiments of the present invention, it is an object of the present invention to provide a waste combustion device and a waste combustion method that contribute to stabilization of a combustion state of waste.

[Solution to Problem]

[0007]

According to at least one embodiment of the present invention, there is provided a waste combustion device including a hopper into which waste is charged, a feeder configured to supply the waste charged into the hopper, a stoker provided in a combustion chamber in which the waste is combusted, a moisture meter configured to measure the moisture content in the waste, and a control device configured to include a calorific value change decision unit configured to determine a calorific value change in the waste based on the moisture content in the waste measured by the moisture meter, an adjustment value determination unit that determines an adjustment value of an operation

amount of the feeder based on a determination result of the calorific value change, and an operation amount control unit that controls the feeder based on the adjustment value.

[0008]

According to at least one embodiment of the present invention, there is provided a waste combustion method including a step of charging waste into a hopper, a step of supplying the waste charged into the hopper onto a stoker in a combustion chamber in which the waste is combusted using a feeder, a step of measuring the moisture content in the waste, a step of deciding a calorific value change in the waste based on the moisture content in the waste measured by the moisture meter, a step of determining the adjustment value of the operation amount of the feeder based on a decision result of the calorific value change, and a step of controlling the feeder based on the adjustment value of the operation amount of the feeder.

[Advantageous Effects of Invention]

[0009]

According to several embodiments of the present invention, the calorific value change in the waste is determined based on the moisture content in the waste measured by the moisture meter, and the adjustment value of the operation amount of the feeder is determined based on the decision result of the calorific value change. As a result, by measuring the moisture content in the waste supplied to the combustion chamber, changes in the quality of the waste can be detected before combustion, the amount of heat input to the combustion chamber is adjusted, which can contribute to the stabilization of the combustion state of waste in the combustion chamber.

[Brief Description of Drawings]

[0010]

Fig. 1 is a schematic configuration diagram of a waste combustion device

according to an embodiment of the present invention.

Fig. 2 is a block diagram of a control device according to an embodiment of the present invention.

Fig. 3 is a table showing an example of the moisture content in waste and a cycle time of a stoker according to an embodiment of the present invention.

Fig. 4 is a block diagram of a control device according to another embodiment of the present invention.

Fig. 5 is a block diagram of a control device according to another embodiment of the present invention.

Fig. 6 is a correlation graph of the moisture content and a calorific value in the waste according to an embodiment of the present invention.

Fig. 7 is a block diagram of a control device according to another embodiment of the present invention.

Fig. 8 is a flowchart of a waste combustion method according to an embodiment of the present invention.

[Description of Embodiments]

[0011]

Hereinafter, several embodiments of the present invention will be described with reference to the accompanying drawings. However, the dimensions, materials, shapes, relative arrangements, and the like of the components described as embodiments or shown in the drawings are not intended to limit the scope of the present invention thereto, but are merely explanatory examples. On the other hand, the expression "is provided with", "includes", or "has" one component is not an exclusive expression that excludes the existence of another component.

[0012]

Fig. 1 is a schematic configuration diagram of a waste combustion device 100 according to an embodiment of the present invention.

Hereinafter, the waste combustion device 100 according to the embodiment of the present invention will be described with reference to Fig. 1. The waste combustion device 100 may be a device for incinerating municipal waste or the like, or may be a device for incinerating industrial waste liquid or the like.

[0013]

As shown in Fig. 1, the waste combustion device 100 according to the embodiment is provided with a hopper 3 into which waste is charged, a feeder 5 for supplying the waste charged in the hopper 3 into a combustion chamber 11, a stoker 7 that receives the waste supplied by the feeder 5 and combusts the waste, the combustion chamber 11 that combusts the waste, a moisture meter 30 that measures a moisture content in waste, and a control device 50. The waste combustion device 100 in the present embodiment may be further provided with a blower 9 disposed below the stoker 7 and for supplying air above the stoker 7 or may be provided with a boiler 15.

[0014]

The hopper 3 temporarily stores the waste, for example, the waste is charged in by a crane (not shown) and the waste is stored.

[0015]

The feeder 5 is provided below the hopper 3, moves the waste supplied onto a feed table 5a through a chute portion 3a of the hopper 3 forward and backward with a predetermined stroke to push the waste out into the combustion chamber 11, and supplies the waste onto the stoker 7 in the combustion chamber 11. The feeder 5 receives a control signal from the control device 50, controls a speed and operation timing of pushing out the waste, and controls the amount of waste supplied to the combustion

chamber 11.

[0016]

The stoker 7 is provided at a bottom portion of the combustion chamber 11, is formed by alternately arranging a fixed fire grate and a movable fire grate that reciprocates in the flow direction of waste, receives the waste supplied into the combustion chamber 11 by the feeder 5, and dries and combusts while moving the waste.

The stoker 7 is provided with a dry fire grate 7a that evaporates and dries moisture in the waste supplied by the feeder 5, a combustion fire grate (pre-combustion fire grate) 7b located in a wake of the dry fire grate 7a and combusting the dried waste, and a post-combustion fire grate 7c located in a wake of the combustion fire grate 7b and combusting uncombusted components such as fixed carbon components passed through without being combusted until the uncombusted components are ash. The stoker 7 receives a control signal from the control device 50 and controls the operating speed of each fire grate.

A wake side of the post-combustion fire grate 7c is connected to an ash outlet 13, and the ash is configured to be discharged from the waste combustion device 100 through the ash outlet 13.

[0017]

The blower 9 is provided below the stoker 7 and supplies primary air (air) to each part of the stoker 7 via an air box 8. The supplied primary air promotes the combustion of waste, for example, in the combustion fire grate 7b. The blower 9 receives a control signal from the control device 50 and controls the amount of blown air.

[0018]

The combustion chamber 11 includes a primary combustion chamber 11a and a secondary combustion chamber 11b above the stoker, and is disposed so that the boiler

15 is connected to the wake thereof. The primary combustion chamber 11a is a region in the furnace in which the waste charged into the furnace is transferred onto the stoker 7 and the waste is incinerated from below the stoker 7 with the primary air. The secondary combustion chamber 11b is provided above the primary combustion chamber 11a, and is a region in the furnace in which uncombusted gas generated from the primary combustion chamber 11a is secondarily combusted by secondary air sent from a blower (not shown) provided in the secondary combustion chamber. When the calorific value changes, the amount of air required for complete combustion of the waste changes. Therefore, the blower that sends the secondary air may also receive a control signal from the control device 50 to control the amount of blown air.

A thermometer 12 for measuring the temperature inside the furnace in the secondary combustion chamber 11b is provided in the combustion chamber 11. The thermometer 12 sends the measured information on the temperature inside the furnace to the control device 50. In Fig. 1, only one thermometer 12 is provided, but a plurality of thermometers 12 may be provided in the secondary combustion chamber 11b. In addition, the thermometer 12 may be provided at an outlet of the combustion chamber 11 or a flue connected to the boiler 15 as long as the combustion state in the combustion chamber can be grasped.

[0019]

The boiler 15 is disposed in a wake of the flow of the exhaust gas generated in the combustion chamber 11, and generates steam by a combustion heat generated in the combustion chamber 11. The boiler 15 exchanges heat with the exhaust gas sent from the combustion chamber 11 and the water circulating in the boiler 15 to generate steam. The flue is provided at the exhaust gas outlet of the boiler 15, and the exhaust gas heat-recovered by the boiler 15 passes through the flue, passes through the exhaust gas

treatment facility, and is discharged to the outside. In the boiler 15, a steam flow rate measuring instrument 16 for measuring the steam flow rate generated by heat exchange between the combustion exhaust gas and water is provided. The steam flow rate measuring instrument 16 sends measured steam flow rate information to the control device 50.

[0020]

The exhaust gas heat-recovered by the boiler 15 passes through the flue, passes through an exhaust gas treatment facility such as a temperature reducing tower 17 that lowers the exhaust gas temperature and a dust collector 19 for removing fly ash from the exhaust gas, is treated, and is discharged to the outside from a chimney 21.

[0021]

The moisture meter 30 is for measuring the moisture content in the waste. The moisture meter 30 may measure the moisture, for example, using electrical resistance value, electrical capacitance, light absorption, and electromagnetic waves, regardless of the type of the measuring instrument as long as the moisture content in the waste can be measured. As shown in Fig. 1, it is desirable that the moisture meter 30 is provided at a lower portion (in the vicinity of outlet) in the hopper 3, that is, at a position where the moisture content in the waste immediately before being pushed out to the combustion chamber 11 by the feeder 5 can be measured. Since it is possible to measure the moisture content in the waste immediately before being supplied to the combustion chamber 11, it is possible to grasp the moisture content in the waste supplied to the stoker 7 before combustion.

In the embodiment shown in Fig. 1, the moisture meter 30 is provided in the vicinity of the outlet in the hopper 3 in order to measure the moisture content in the waste in the vicinity of the outlet, but the installation position of the moisture meter 30 is not

limited to this case, and the moisture meter may measure the moisture content in the waste in the vicinity of the inlet or outlet of the hopper 3.

[0022]

In addition, as shown in Fig. 1, the moisture meter 30 is not limited to the case where the moisture meter 30 is provided at a position where the moisture content in the waste at the outlet portion in the hopper 3 can be measured, and may be provided at any position, for example, a position where the moisture content in waste in the central portion or the upper portion in the hopper 3 can be measured. In a case where the moisture meter 30 is provided at a position where the moisture content in the waste in the central portion of the hopper 3 can be measured, the waste whose moisture content is measured is supplied to the combustion chamber 11 after a certain period of time, and it is possible to grasp the moisture content in the waste supplied to the stoker 7 by measuring the timing of supply. Furthermore, the moisture meter 30 is not limited to the case where the moisture content in the waste in the hopper 3 can be measured, and may be provided at an upstream upper position of the stoker 7, that is, at a position where the moisture content in the waste immediately after being supplied into the combustion chamber 11 can be measured. In a case where the moisture meter 30 is provided at a position where the moisture content in the waste at the upstream upper position of the stoker 7 can be measured, the moisture content in the waste supplied to the stoker 7 can be directly grasped. The number of moisture meters 30 is not limited to one, and a plurality of moisture meters 30 may be provided. For example, each may be provided at a position where the moisture content in the waste in the upper part, the center, and the lower part in the hopper can be measured, and the accurate temperature distribution of the waste in the hopper 3 may be measured.

[0023]

Fig. 2 is a block diagram of the control device 50 according to the embodiment of the present invention.

As shown in Fig. 2, the control device 50 includes a calorific value change decision unit 52 that determines a calorific value change in the waste, the adjustment value determination unit 54 that determines the adjustment values of the operation amounts of the feeder 5 and the stoker 7 based on the decision result of the calorific value change, an operation amount calculation unit 56 that calculates the operation amounts of the feeder 5 and the stoker 7 from the target steam flow rate, and an operation amount control unit 58 that controls the feeder 5 and the stoker 7 by the operation amount calculated by the operation amount calculation unit 56 and the adjustment values of the operation amounts of the feeder 5 and the stoker 7 determined by the adjustment value determination unit 54.

[0024]

The calorific value change decision unit 52 determines the calorific value change in the waste based on the moisture content in the waste measured by the moisture meter 30. The calorific value change decision unit 52 receives information on the moisture content in the waste from the moisture meter 30, compares the information with a reference moisture content set in advance, and may determine that the calorific value is changed when the difference increases or decreases beyond a predetermined threshold value. The reference moisture content is a reference value of the moisture content for grasping the change in the quality of the waste. For example, the moisture content in the waste before a predetermined time may be set as the reference moisture content, or the moving average of the moisture content in the waste acquired from the moisture meter 30 over time may be set as the reference moisture content. In addition, the reference moisture content may be set by the user according to the type of waste, for

example, when the type of waste is determined to some extent.

[0025]

Generally, the higher the contained moisture content in the waste, the lower the calorific value, and the lower the contained moisture content, the higher the calorific value. Therefore, for example, the calorific value change decision unit 52 determines that the calorific value in the waste is decreased when the moisture content in the waste increases from the reference moisture content by a predetermined threshold value or more, and determines that the calorific value in the waste is increased when the moisture content in the waste decreases from the reference moisture content by a predetermined value or more. When the amount of change in the calorific value in the waste increases or decreases by a predetermined value or more, the calorific value change decision unit 52 sends information on the amount of change in the waste to the adjustment value determination unit 54 as a decision result.

[0026]

The adjustment value determination unit 54 determines the adjustment value of the operation amount of each of the feeder 5 and the stoker 7 so that the amount of heat input to the combustion chamber 11 (the amount of charged waste) is constant, based on the decision result of the calorific value change determined by the calorific value change decision unit 52. The adjustment value determination unit 54 may determine the adjustment values of the operation amounts of the feeder 5 and the stoker 7 according to the amount of change in the calorific value in the waste. The adjustment value determination unit 54 sends the determined adjustment value information to the operation amount control unit 58.

[0027]

The operation amount calculation unit 56 calculates each of the operation

amounts of the feeder 5 and the stoker 7 so that necessary waste (the amount of heat input) is charged into the combustion chamber 11 in order for the steam flow rate measured by the steam flow rate measuring instrument 16 to match the target steam flow rate of the boiler 15. More specifically, the operation amount calculation unit 56 calculates the operation amount of the feeder 5 in order to adjust the amount of waste (the amount of heat input) supplied into the combustion chamber 11 so that the current steam flow rate matches the target steam flow rate, and calculates the operation amount of the stoker 7 in order to adjust the combustion heat. The operation amount calculation unit 56 sends the calculated operation amounts of the feeder 5 and the stoker 7 to the operation amount control unit 58. The target steam flow rate is a target steam flow rate generated by the boiler 15, and is appropriately set based on information such as the amount of power generated by a power generation device that generates power using steam.

[0028]

The operation amount control unit 58 calculates the operation amounts of the feeder 5 and the stoker 7 calculated by the operation amount calculation unit 56 and the adjustment values of the operation amounts of the feeder 5 and the stoker 7 determined by the adjustment value determination unit 54 to control each of the feeder 5 and the stoker 7.

[0029]

Here, an example of adjusting the operation amounts of the feeder 5 and the stoker 7 will be described with reference to Fig. 3. It is assumed that the reference moisture content is 50%, and the calorific value change decision unit 52 determines that the calorific value is changed in a case where the moisture content changes by a predetermined threshold value (2%) or more from the reference moisture content. In a

case where the moisture content acquired from the moisture meter 30 is 53% and when the difference from the reference moisture content is 2% or more, the calorific value change decision unit 52 determines that the calorific value is changed. Next, the adjustment value determination unit 54 determines the adjustment value so as to increase the speed of the feeder 5 in order to increase the supply amount of waste in order to keep the heat input constant. On the other hand, when the moisture content increases (the fuel calorie decreases), there is a problem that the drying distance of the stoker 7 increases and the burnout length increases. Therefore, the adjustment value determination unit 54 determines the adjustment value so as to reduce the speed of the stoker to reduce the fire grate speed of the combustion fire grate 7b and the post-combustion fire grate 7c to increase the residence time and reduce the burnout length.

[0030]

According to the control device 50 of the embodiment shown in Fig. 2, by measuring the moisture content in the waste supplied to the combustion chamber, in addition to the operation amounts of the feeder 5 and the stoker 7 calculated by the operation amount calculation unit 56, so as to match the target steam flow rate, the change in the quality of waste can be detected before combustion and the operation amounts of the feeder 5 and the stoker 7 can be adjusted in consideration of the change in quality in advance. Therefore, it is possible to stabilize the combustion state and the amount of evaporation.

[0031]

In the control device 50 of the embodiment shown in Fig. 2 described above, the operation amount calculation unit 56 is provided and described, but the operation amount calculation unit 56 may be omitted. For example, in a case where the target steam flow rate is constant and the change in properties of the quality of the waste is small, the

operation amount of the feeder 5 or the like may be set in advance, and the operation amount control unit 58 may control the feeder 5 or the like by adding an adjustment value of the operation amount according to the moisture content in the waste to the operation amount of the feeder 5 or the like set in advance.

In addition, although the feeder 5 and the stoker 7 are described as control targets in the adjustment value determination unit 54 and the operation amount control unit 58, the present disclosure is not limited thereto. For example, when the burnout length of the stoker 7 does not matter, only the feeder 5 may be controlled. That is, the amount of waste supplied to the combustion chamber 11 may be adjusted by controlling the operation amount of the feeder 5 according to the moisture content in the waste.

[0032]

Fig. 4 is a block diagram of the control device 50 according to another embodiment of the present invention. In the following, the description of the configuration common to the control device 50 shown in Fig. 2 will be omitted as appropriate.

In the control device 50 of the embodiment shown in Fig. 4, the calorific value change decision unit 52 may determine the calorific value change in the waste in the combustion chamber 11 based on the gas temperature measured by thermometer 12 in addition to the moisture content in the waste measured by the moisture meter 30. The calorific value change decision unit 52 receives information on the gas temperature in the combustion chamber 11 by the thermometer 12, compares the information with a reference gas temperature set in advance, and may determine that the calorific value is changed when the difference increases or decreases beyond a predetermined threshold value. The reference gas temperature is a reference value of the gas temperature for generating the target steam flow rate, and may be determined by the target steam flow

rate. For example, in a case where the calorific value change decision unit 52 determines that the gas temperature is changed from the reference gas temperature by a predetermined threshold value or more, it can be said that the combustion heat of the waste on the stoker 7 fluctuates.

With the above configuration, in addition to the moisture content in the waste, the calorific value change in the waste in the combustion chamber is determined based on the gas temperature and steam flow rate in the combustion chamber, so that even in a case where the amount of heat input to the waste supplied to the combustion chamber fluctuates to some extent, the fluctuation in combustion heat can be suppressed.

[0033]

In a case where the calorific value change decision unit 52 determines that the gas temperature is changed by a predetermined threshold value or more, the adjustment value determination unit 54 may determine at least one adjustment value of the operation amount of the stoker 7 and the operation amount of the blower 9 supplying air to the stoker 7 from below the stoker 7 disposed at the bottom portion of the combustion chamber 11.

For example, when the gas temperature is reduced by a predetermined threshold value or more, the adjustment value determination unit 54 determines that the combustion heat of the waste on the stoker 7 is reduced, and determines the adjustment value of the operation amount of the blower 9 in order to increase the amount of primary air in order to promote the combustion of waste.

[0034]

The operation amount calculation unit 56 calculates the operation amount of the blower 9 in addition to the operation amounts of the feeder 5 and the stoker 7. The operation amount control unit 58 calculates the operation amounts of the feeder 5, the

stoker 7 and the blower 9 calculated by operation amount calculation unit 56 and the adjustment values of the operation amounts of the feeder 5, the stoker 7, and the blower 9 determined by the adjustment value determination unit 54, and controls each of the feeder 5, the stoker 7, and the blower 9. For example, in a case where the calorific value change decision unit 52 determines that the gas temperature is changed from the reference gas temperature by a predetermined threshold value or more, the adjustment value determination unit 54 determines the adjustment value of the operation amount of the blower 9. In the operation amount control unit 58, the adjustment value of the operation amount of the blower 9 determined by the adjustment value determination unit 54 is added to the operation amount of the blower 9 calculated by the operation amount calculation unit 56. As a result, the amount of primary air can be increased to promote combustion, and the amount of volatile matter generated from the solid matter of waste or biomass can be increased.

[0035]

Fig. 5 is a block diagram of the control device 50 according to another embodiment of the present invention. In the following, the description of the configuration common to the control device 50 shown in Fig. 2 will be omitted as appropriate.

The control device 50 shown in Fig. 5 further includes a storage unit 60 that stores a correlation graph between the moisture content in the waste and the calorific value in the waste, a calorific value calculation unit 62 that calculates the calorific value from the steam flow rate measured by the steam flow rate measuring instrument 16, and an update unit 64 that updates the calorific value calculated by the calorific value calculation unit 62 and the correlation graph stored in the storage unit 60 from the moisture content in the waste measured by the moisture meter 30.

[0036]

The calorific value change decision unit 52 determines the calorific value change in the waste based on the moisture content in the waste measured by the moisture meter 30, and the relationship between the moisture content and the calorific value in the waste in the waste stored in the storage unit 60. In the present embodiment, the relationship between the moisture content in the waste and the calorific value in the waste is shown in the case where the relationship is stored in the storage unit 60 as a correlation graph, but it may be stored in the storage unit 60 as a correspondence table. Fig. 6 is a correlation graph according to the embodiment of the present invention. In the graph shown in Fig. 6, the horizontal axis represents the moisture content in the waste and the vertical axis represents the calorific value in the waste. Since there is a correlation between the moisture content in waste and the calorific value in waste, the calorific value can be calculated using the correlation graph when the moisture content in waste is measured. Therefore, the calorific value change decision unit 52 accesses the storage unit 60 after acquiring the moisture content in the waste measured by the moisture meter 30, and acquires the calorific value according to the acquired moisture content. The calorific value change decision unit 52 may acquire the calorific value from the moisture content acquired after a predetermined time and determine whether or not the calorific value is changed by a threshold value or more from the previous calorific value.

[0037]

The calorific value calculation unit 62 acquires the steam flow rate measured by the steam flow rate measuring instrument 16 and the moisture content measured by the moisture meter 30, and calculates the calorific value. The calorific value calculation unit 62 sends the moisture content and the data of the calorific value calculated using the

moisture content to the update unit 64.

[0038]

The update unit 64 reads the data of the correlation graph from the storage unit 60, adds the data of the moisture content and the calorific value acquired from the calorific value calculation unit 62, updates the correlation graph of the moisture content and the calorific value, and stores the updated correlation graph in the storage unit 60. In the update unit 64, by updating the calorific value and the correlation graph stored in the storage unit 60 from the moisture content in the waste measured by the moisture meter 30, the correlation graph is updated at any time to be a correlation graph that matches the change in waste quality, and the calorific value change can be accurately determined. The adjustment value of the adjustment target (feeder 5, stoker 7, blower 9, and the like) can be calculated to stabilize the combustion state.

[0039]

According to the control device 50 shown in Fig. 5, the calorific value calculation unit 62 and the update unit 64 prepare a correlation graph that reflects the quality of waste that can change from moment to moment in real time, and the calorific value change decision unit 52 determines the calorific value change. Therefore, the change in quality of the waste can be more accurately reflected in the control of the adjustment target (feeder 5, stoker 7, blower 9, and the like).

[0040]

Although the control device 50 shown in Fig. 5 is described by taking the case where the calorific value calculation unit 62 and the update unit 64 are provided as an example, the present invention is not limited thereto, and these units may be omitted. For example, in a case where the type of waste is determined to some extent depending on the day or season, the user may appropriately select the correlation graph according to

the type of waste.

[0041]

Fig. 7 is a block diagram of a control device 50 according to another embodiment of the present invention. In the following, the description of the configuration common to the above-described control device 50 will be omitted as appropriate.

In the control device 50 shown in Fig. 7, the storage unit 60 stores an operation amount map showing a correspondence relationship between the target steam flow rate of the boiler 15, the calorific value change information on the waste, and the adjustment value of the feeder 5. The adjustment value determination unit 54 determines the adjustment value of the operation amount of the feeder 5 from the result of the calorific value change, the target steam flow rate of the boiler 15, and the operation amount map stored in the storage unit 60. For example, the operation amount map is a map in which the adjustment values of the operation amounts of the feeder 5 and the stoker 7 which are the target steam flow rate is calculated by thermal fluid analysis or the like from the input of the gas temperature and the steam flow rate as a result of the calorific value change.

With the above configuration, the operation amount of the feeder 5 is adjusted by using the information on the target steam flow rate of the boiler 15, so that the target steam flow rate can be further achieved.

[0042]

Specifically, the adjustment value determination unit 54 receives the input of the gas temperature and the steam flow rate as a result of the calorific value change, reads the operation amount map from the storage unit 60, and determines the adjustment values of the operation amounts of the feeder 5 and the stoker 7 based on the operation amount map.

[0043]

By using the operation amount map, the adjustment value of the operation amount such as the feeder 5 calculated by the thermal fluid analysis can be accurately determined, and the adjustment value of the operation amount can be assigned as a preceding signal, so that it is possible to quickly suppress the fluctuation of the steam flow rate.

[0044]

In addition, in the control device 50 shown in Fig. 7, the storage unit 60 may store a dynamic physical model of the waste combustion device 100 instead of the operation amount map, and the adjustment value determination unit 54 may acquire the target steam flow rate of the boiler 15 and the calorific value change information on the waste, and determine the adjustment value of the operation amount of the feeder 5 from the dynamic physical model stored in the storage unit 60. That is, the adjustment value is calculated via a dynamic physical model showing the action of an external force such as the feeder 5 with respect to the components of the gas temperature and the steam flow rate as a result of the calorific value change. The physical model can be obtained from theoretical calculations.

The adjustment value of the operation amount of the feeder 5 is calculated by a dynamic physical model from not only the calorific value change information on the waste but also the target steam flow rate of the boiler 15 and the operation amount of the feeder 5. Therefore, the adjustment value of the operation amount of the feeder 5 can be determined more accurately.

[0045]

Fig. 8 is a flowchart of a waste combustion method according to an embodiment of the present invention. Hereinafter, the waste combustion method according to the

embodiment will be described with reference to Fig. 8. A case where the feeder 5 is controlled by using the control device 50 shown in Fig. 2 will be described as an example.

[0046]

The waste combustion method according to one embodiment includes a step (S1) of charging the waste into the hopper 3, a step (S2) of supplying the waste charged into the hopper 3 onto the stoker 7 in the combustion chamber 11 in which the waste is combusted using the feeder 5, a step (S3) of measuring the moisture content in the waste, a step (S4) of deciding the calorific value change in the waste based on the moisture content in the waste measured by the moisture meter 30, a step (S5) of determining the adjustment value of the operation amount of the feeder 5 based on the result of the calorific value change, and a step (S6) of controlling the feeder 5 based on the adjustment value of the operation amount of the feeder 5.

[0047]

The control device 50 specifically performs the following operations in each of the above steps S2 to S6. In step S2, the operation amount calculation unit 56 calculates the operation amount of the feeder 5 so that the steam flow rate acquired from the steam flow rate measuring instrument 16 matches the target steam flow rate. The operation amount control unit 58 operates the feeder 5 based on the calculated operation amount, and supplies the waste charged into the hopper 3 onto the stoker 7 in the combustion chamber 11 that combusts the waste using the feeder 5.

[0048]

In step S3, the moisture meter 30 measures the moisture content in the waste, and the control device 50 receives the information on the measured moisture content in the waste. The timing for measuring the moisture content in the waste can be set as

appropriate.

[0049]

In step S4, the calorific value change decision unit 52 determines whether or not the calorific value change in the waste is equal to or more than a predetermined threshold value based on the moisture content in the waste measured by the moisture meter 30.

[0050]

In step S5, the adjustment value determination unit 54 determines the adjustment value of the operation amount of the feeder 5 based on the result of the calorific value change. In a case where it is a decision result that the calorific value change is equal to or more than a predetermined threshold value, the adjustment value determination unit 54 determines the adjustment value according to the change amount, and in a case where it is a decision result that the calorific value change is not equal to or more than the predetermined threshold value, the adjustment value is determined as 0.

[0051]

In step S6, the operation amount control unit 58 controls the operation amount of the feeder 5 based on the adjustment value of the operation amount of the feeder 5.

[0052]

In the present waste combustion method, the calorific value change in the waste is determined based on the moisture content in the waste measured by the moisture meter 30, and the adjustment value of the operation amount of the feeder 5 is determined based on the result of the calorific value change. As a result, the amount of waste charged into the combustion chamber 11 can be adjusted, and the amount of heat input into the combustion chamber 11 is adjusted, which can contribute to the stabilization of the combustion state of the waste in the combustion chamber 11 and the stabilization of the steam flow rate. Furthermore, the moisture content in the waste at a predetermined

position is measured by the moisture meter 30, and the calorific value change in the waste is determined based on the measured moisture content and reflected in the control of the amount of waste charged into the combustion chamber 11. Therefore, it is possible to contribute to further stabilization of the combustion state of the waste and stabilization of the steam flow rate.

[0053]

The waste combustion device 100 described in each embodiment is grasped as follows, for example.

[0054]

(1) The waste combustion device 100 according to a first aspect includes the hopper 3 into which the waste is charged, the feeder 5 that supplies the waste charged into the hopper 3, the stoker 7 provided in the combustion chamber 11 in which the waste is combusted, the boiler 15 that generates steam by the combustion heat generated in the combustion chamber 11, the moisture meter 30 that measures the moisture content in the waste, and the control device 50 including the calorific value change decision unit 52 that determines the calorific value change in the waste based on the moisture content in the waste measured by the moisture meter 30, the adjustment value determination unit 54 that determines the adjustment value of the operation amount of the feeder 5 based on the decision result of the calorific value change, and the operation amount control unit 58 that controls the feeder 5 according to the adjustment value of the operation amount of the feeder 5 determined by the adjustment value determination unit 54.

[0055]

In the waste combustion device 100 according to the first aspect, the calorific value change in the waste is determined based on the moisture content in the waste measured by the moisture meter 30, and the adjustment value of the operation amount of

the feeder 5 is determined based on the result of the calorific value change. As a result, the amount of waste charged into the combustion chamber 11 can be adjusted, and the amount of heat input into the combustion chamber 11 is adjusted, which can contribute to the stabilization of the combustion state of the waste in the combustion chamber 11 and the stabilization of the steam flow rate. Furthermore, the moisture content in the waste at a predetermined position is measured by the moisture meter 30, and the calorific value change in the waste is determined based on the measured moisture content and reflected in the control of the amount of waste charged into the combustion chamber 11. Therefore, it is possible to contribute to further stabilization of the combustion state of the waste and stabilization of the steam flow rate.

[0056]

(2) The waste combustion device 100 according to the second aspect is the waste combustion device 100 according to the first aspect, and further includes the boiler 15 that generates steam by the combustion heat generated in the combustion chamber 11, and the steam flow rate measuring instrument 16 that measures the steam flow rate of the boiler 15, in which the control device 50 further includes the operation amount calculation unit 56 that calculates the operation amount of the feeder 5 so that the steam flow rate measured by the steam flow rate measuring instrument 16 matches the target steam flow rate of the boiler 15, and the operation amount control unit 58 controls the feeder 5 by calculating the operation amount of the feeder 5 calculated by the operation amount calculation unit 56 and the adjustment value of the operation amount of the feeder 5 determined by the adjustment value determination unit 54.

[0057]

In the waste combustion device 100 according to the second aspect, the operation amount of the feeder 5 is calculated so that the target steam flow rate of the

boiler 15 matches the steam flow rate measured by the steam flow rate measuring instrument 16. The operation amount of the feeder 5 is adjusted based on the operation amount of the feeder 5 and the result of the calorific value change based on the moisture content in the waste. As a result, the operation amount of the feeder is determined so as to be the target steam flow rate, and the operation amount is adjusted according to the moisture content in the waste, so that it is possible to quickly respond to the change of the target steam flow rate.

[0058]

(3) The waste combustion device 100 according to a third aspect is the waste combustion device 100 according to the second aspect, in which the operation amount calculation unit 56 calculates the operation amounts of the feeder 5 and the stoker 7 so that the steam flow rate measured by the steam flow rate measuring instrument 16 matches the target steam flow rate of the boiler 15, the adjustment value determination unit 54 determines the adjustment value of the operation amount of each of the feeder 5 and the stoker 7 based on the decision result of the calorific value change, and the operation amount control unit 58 calculates the operation amounts of the feeder 5 and the stoker 7 calculated by the operation amount calculation unit 56 and the adjustment values of the operation amounts of the feeder 5 and the stoker 7 determined by the adjustment value determination unit 54, and controls the feeder 5 and the stoker 7.

[0059]

In the waste combustion device 100 according to the third aspect, the operation amounts of the feeder 5 and the stoker 7 are determined so that the target steam flow rate of the boiler 15 and the steam flow rate measured by the steam flow rate measuring instrument 16 match. The operation amounts of the feeder 5 and the stoker 7 are adjusted based on the result of the calorific value change based on the moisture content in

the waste. As a result, the feeder 5 can control the amount of waste supplied to the combustion chamber 11, that is, the amount of heat input according to the moisture content in the waste, and the combustion state of the waste can also be controlled to stabilize the steam flow rate.

[0060]

(4) The waste combustion device 100 according to a fourth aspect is the waste combustion device 100 according to the first to third aspects, in which the calorific value change decision unit 52 determines the calorific value change in the waste based on the difference between the moisture content in the waste and the moving average of the moisture content in the waste before the predetermined time or the moisture content in the waste acquired over time.

[0061]

In the waste combustion device 100 according to the fourth aspect, when the difference occurs between the moisture content in the waste and the moving average of the moisture content in the waste before a predetermined time or the moisture content in the waste acquired over time, by deciding the calorific value change in the waste, even when the quality of the waste (moisture content) changes, the adjustment target (feeder 5, stoker 7, blower 9, and the like) can be controlled based on the calorific value change, which can contribute to the stabilization of the combustion state and the stabilization of the steam flow rate.

[0062]

(5) The waste combustion device 100 according to a fifth aspect is the waste combustion device 100 according to the first to third aspects, in which the control device 50 further includes the storage unit 60 that stores the relationship between the moisture content in the waste and the calorific value in the waste, and the calorific value change

decision unit 52 determines the calorific value change in the waste based on the moisture content in the waste measured by the moisture meter 30, and the relationship between the moisture content in the waste and the calorific value in the waste stored in the storage unit 60.

[0063]

In the waste combustion device 100 according to the fifth aspect, even when the quality of the waste changes, the feeder 5 can be controlled so that the amount of heat input to the combustion chamber 11 is constant based on the calorific value change determined from the moisture content in the waste and the correlation graph, which can contribute to the stabilization of the combustion state and the stabilization of the steam flow rate.

[0064]

(6) The waste combustion device 100 according to a sixth aspect is the waste combustion device 100 according to the fifth aspect, in which the control device 50 further includes the calorific value calculation unit 62 that calculates the calorific value from the steam flow rate measured by the steam flow rate measuring instrument 16, and the update unit 64 that update the relationship between the moisture content in the waste and the calorific value in the waste stored in the storage unit 60 from the calorific value calculated by the calorific value calculation unit 62 and the moisture content in the waste measured by the moisture meter 30.

[0065]

In the waste combustion device 100 according to the sixth aspect, the correlation graph is updated at any time from the calorific value calculated by the calorific value calculation unit 62 and the moisture content in the waste measured by the moisture meter 30, so that it is possible to determine the calorific value change to the current situation.

[0066]

(7) The waste combustion device 100 according to a seventh aspect is the waste combustion device 100 according to the first to sixth aspects, and further includes the thermometer 12 that measures the gas temperature in the combustion chamber 11, in which the calorific value change decision unit 52 determines the calorific value change in the waste in the combustion chamber 11 based on the moisture content in the waste measured by the moisture meter 30 and the gas temperature measured by the thermometer 12.

[0067]

In the waste combustion device 100 according to the seventh aspect, since the calorific value change is further determined by using the gas temperature, it is possible to determine the calorific value change based on more information in the combustion chamber 11.

[0068]

(8) The waste combustion device 100 according to an eighth aspect is the waste combustion device 100 according to the seventh aspect, in which in a case where the calorific value change decision unit 52 determines that the gas temperature is changed by a certain amount or more, the adjustment value determination unit 54 determines at least one of the adjustment value of the operation amount of the stoker 7 and the adjustment value of the operation amount of the blower 9 supplying air to the stoker 7 disposed at the bottom portion in the combustion chamber 11 from below the stoker 7, and the operation amount control unit 58 controls at least one of the stoker 7 and the blower 9 based on at least one of the adjustment value of the operation amount of the stoker 7 determined by the adjustment value determination unit 54 and the adjustment value of the operation amount of the blower 9 determined by the adjustment value determination unit

54.

[0069]

In the waste combustion device 100 according to the eighth aspect, in a case where the gas temperature changes by a certain amount or more, the operation amount of the stoker 7 or the blower 9 is adjusted, so that it is possible to control the combustion state of the waste on the stoker 7 and stabilize the combustion state.

[0070]

(9) The waste combustion device 100 according to a ninth aspect is the waste combustion device 100 according to the first to eighth aspects, in which the stoker 7 includes the dry fire grate 7a that dries the waste supplied by the feeder 5 and the combustion fire grate 7b disposed in the wake of the dry fire grate 7a, the adjustment value determination unit 54 determines the adjustment value of the speed of the combustion fire grate 7b of the stoker 7 according to the moisture content in the waste measured by the moisture meter 30, and the operation amount control unit 58 controls the speed of the combustion fire grate 7b based on the adjustment value of the speed of the combustion fire grate 7b determined by the adjustment value determination unit 54.

[0071]

In the waste combustion device 100 according to the ninth aspect, since the speed of the combustion fire grate 7b is adjusted according to the moisture content in the waste measured by the moisture meter 30, it is possible to control the combustion state of the waste on the combustion fire grate 7b and promote the complete combustion of the waste on the combustion fire grate 7b.

[0072]

(10) The waste combustion device 100 according to a tenth aspect is the waste combustion device 100 according to the fifth aspect, in which the storage unit 60 stores

the operation amount map showing the correspondence relationship between the target steam flow rate of the boiler 15, the calorific value change information on the waste, and the adjustment value of the feeder 5, and the adjustment value determination unit 54 determines the adjustment value of the operation amount of the feeder 5 from the result of the calorific value change, the target steam flow rate of the boiler 15, and the operation amount map stored in the storage unit 60.

[0073]

In the waste combustion device 100 according to the tenth aspect, the adjustment value of the operation amount of the feeder 5 is determined based on the operation amount map showing the correspondence relationship between the target steam flow rate of the boiler 15, the calorific value change information on the waste, and the adjustment value of the feeder 5. Therefore, the operation amount of the feeder 5 is adjusted by using the information on the target steam flow rate of the boiler 15, so that the target steam flow rate can be further achieved.

[0074]

(11) The waste combustion device 100 according to an eleventh aspect is the waste combustion device 100 according to the fifth aspect, in which the storage unit 60 stores the dynamic physical model of the waste combustion device 100, and the adjustment value determination unit 54 acquires the target steam flow rate of the boiler 15 and the calorific value change information on the waste, and determines the adjustment value of the operation amount of the feeder 5 from the dynamic physical model stored in the storage unit 60.

[0075]

In the waste combustion device 100 according to the eleventh aspect, by calculating the adjustment value of the operation amount of the feeder 5 by the dynamic

physical model, the adjustment value of the operation amount of the feeder 5 can be determined more accurately.

[0076]

(12) The waste combustion device 100 according to a twelfth aspect is the waste combustion device 100 according to the first aspect, in which the moisture meter 30 is installed in the vicinity of the inlet or outlet of the hopper 3 into which the waste is charged, and measures the moisture content in the waste.

[0077]

In the waste combustion device 100 according to the twelfth aspect, by installing the moisture meter 30 in the vicinity of the inlet of the hopper 3, it is possible to measure the moisture content in the waste immediately after being supplied to the hopper 3. In addition, by installing the moisture meter 30 in the vicinity of the outlet of the hopper 3, it is possible to measure the moisture content in the waste immediately before being supplied to the combustion chamber 11, and grasp the moisture content in the waste supplied to the stoker 7 before combustion.

[0078]

(13) The waste combustion method according to a thirteenth aspect includes the step S1 of charging waste into the hopper 3, the step S2 of supplying the waste charged into the hopper 3 onto the stoker 7 in the combustion chamber 11 in which the waste is combusted using the feeder 5, the step S3 of measuring the moisture content in the waste, the step S4 of deciding the calorific value change in the waste based on the moisture content in the waste measured the moisture meter 30, the step S5 of determining the adjustment value of the operation amount of the feeder 5 based on the decision result of the calorific value change, and the step S6 of controlling the feeder 5 based on the adjustment value of the operation amount of the feeder 5.

[0079]

In the waste combustion method according to the thirteenth aspect, the calorific value change in the waste is determined based on the moisture content in the waste measured by the moisture meter 30, and the adjustment value of the operation amount of the feeder 5 is determined based on the result of the calorific value change. As a result, the amount of waste charged into the combustion chamber 11 can be adjusted, and the amount of heat input into the combustion chamber 11 is adjusted, which can contribute to the stabilization of the combustion state of the waste in the combustion chamber 11 and the stabilization of the steam flow rate. Furthermore, the moisture content in the waste at a predetermined position is measured by the moisture meter 30, and the calorific value change is determined based on the measured moisture content and reflected in the control of the amount of waste charged into the combustion chamber 11. Therefore, it is possible to contribute to further stabilization of the combustion state of the waste and stabilization of the steam flow rate.

[0080]

The present invention is not limited to the above-described embodiment, and includes a modification of the above-described embodiment and a combination of these embodiments as appropriate.

[Industrial Applicability]

[0081]

The present invention relates to a waste combustion device such as a waste incinerator and a waste combustion method. According to the present invention, the combustion state of waste in the combustion chamber can be stabilized.

[Reference Signs List]

[0082]

3: Hopper

5: Feeder

7: Stoker

8: Air box

9: Blower

11: Combustion chamber

13: Ash outlet

15: Boiler

16: Steam flow rate measuring instrument

17: Temperature reducing tower

19: Dust collector

21: Chimney

30: Moisture meter

50: Control device

52: Calorific value change decision unit

54: Adjustment value determination unit

56: Operation amount calculation unit

58: Operation amount control unit

60: Storage unit

62: Calorific value calculation unit

64: Update unit

100: Waste combustion device

[CLAIMS]

What is claimed is:

[Claim 1]

A waste combustion device comprising:

a hopper into which waste is charged;

a feeder configured to supply the waste charged into the hopper;

a stoker provided in a combustion chamber in which the waste is combusted;

a moisture meter configured to measure a moisture content in the waste supplied to the feeder; and

a control device, wherein

the control device includes

a calorific value change decision unit that determines a calorific value change in the waste based on the moisture content in the waste measured by the moisture meter,

an adjustment value determination unit that determines an adjustment value of an operation amount of the feeder based on a decision result of the calorific value change, and

an operation amount control unit that controls the feeder based on the adjustment value,

the waste combustion device further comprises

a boiler configured to generate steam by a combustion heat generated in the combustion chamber; and

a steam flow rate measuring instrument configured to measure a steam flow rate of the boiler,

the control device further includes an operation amount calculation unit that calculates the operation amount of the feeder so that the steam flow rate measured by the

steam flow rate measuring instrument matches a target steam flow rate of the boiler,

the operation amount control unit controls the feeder by calculating the operation amount of the feeder calculated by the operation amount calculation unit and the adjustment value of the operation amount of the feeder determined by the adjustment value determination unit,

the control device further includes a storage unit that stores a relationship between the moisture content in the waste and a calorific value in the waste,

the calorific value change decision unit determines the calorific value change in the waste based on the moisture content in the waste measured by the moisture meter, and the relationship between the moisture content in the waste and the calorific value in the waste stored in the storage unit, and

the control device further includes

a calorific value calculation unit that calculates a calorific value from the steam flow rate measured by the steam flow rate measuring instrument, and

an update unit that updates the relationship between the moisture content in the waste and the calorific value in the waste stored in the storage unit from the calorific value calculated by the calorific value calculation unit and the moisture content in the waste measured by the moisture meter.

[Claim 2]

The waste combustion device according to Claim 1, wherein

the operation amount calculation unit calculates operation amounts of the feeder and the stoker so that the steam flow rate measured by the steam flow rate measuring instrument matches the target steam flow rate of the boiler,

the adjustment value determination unit determines an adjustment values of the operation amount of each of the feeder and the stoker based on the decision result of the

calorific value change, and

the operation amount control unit calculates the adjustment values of the operation amounts of the feeder and the stoker calculated by the operation amount calculation unit, and controls each of the feeder and the stoker.

[Claim 3]

The waste combustion device according to Claim 1 or 2, further comprising:

a thermometer configured to measure a gas temperature in the combustion chamber, wherein

the calorific value change decision unit determines the calorific value change in the waste in the combustion chamber based on the moisture content in the waste measured by the moisture meter and the gas temperature measured by the thermometer.

[Claim 4]

The waste combustion device according to Claim 3, wherein

in a case where the calorific value change decision unit determines that the gas temperature is changed by a certain amount or more, the adjustment value determination unit determines at least one of an adjustment value of an operation amount of the stoker and an adjustment value of an operation amount of a blower supplying air to a stoker disposed at a bottom portion in the combustion chamber from below the stoker, and

the operation amount control unit controls at least one of the stoker and the blower based on at least one of the adjustment value of the operation amount of the stoker determined by the adjustment value determination unit and the adjustment value of the operation amount of the blower determined by the adjustment value determination unit.

[Claim 5]

The waste combustion device according to any one of Claims 1 to 4, wherein

the stoker includes a dry fire grate that dries the waste supplied by the feeder and a combustion fire grate disposed in a wake of the dry fire grate,

the adjustment value determination unit determines an adjustment value of a speed of the combustion fire grate of the stoker according to the moisture content in the waste measured by the moisture meter, and

the operation amount control unit controls the speed of the combustion fire grate based on the adjustment value of the speed of the combustion fire grate determined by the adjustment value determination unit.

[Claim 6]

The waste combustion device according to any one of Claims 1 to 5, wherein

the storage unit stores an operation amount map showing a correspondence relationship between the target steam flow rate of the boiler, and calorific value change information on the waste, and the adjustment value of the feeder, and

the adjustment value determination unit determines the adjustment value of the operation amount of the feeder from a result of the calorific value change, the target steam flow rate of the boiler, and the operation amount map stored in the storage unit.

[Claim 7]

The waste combustion device according to any one of Claims 1 to 6, wherein

the storage unit stores a dynamic physical model of the waste combustion device, and

the adjustment value determination unit acquires the target steam flow rate of the boiler and calorific value change information on the waste , and determines the adjustment value of the operation amount of the feeder from the dynamic physical model stored in the storage unit.

[Claim 8]

The waste combustion device according to any one of Claims 1 to 7, wherein

the moisture meter is installed in a vicinity of an inlet or outlet of the hopper into which the waste is charged, and measures the moisture content in the waste.

[Claim 9]

A waste combustion method comprising:

a charging step of charging waste into a hopper;

a supply step of supplying the waste charged into the hopper onto a stoker in a combustion chamber in which the waste is combusted using a feeder;

a measurement step of measuring a moisture content in the waste;

a decision step of deciding a calorific value change in the waste based on the moisture content in the waste measured in the measurement step;

a determination step of determining an adjustment value of an operation amount of the feeder based on a decision result of the calorific value change;

a control step of controlling the feeder based on the adjustment value of the operation amount of the feeder;

a steam generation step of generating steam in a boiler by a combustion heat generated in the combustion chamber;

a steam flow rate measurement step of measuring a steam flow rate of the boiler by a steam flow rate measuring instrument; and

an operation amount calculation step of calculating the operation amount of the feeder so that the steam flow rate measured by the steam flow rate measuring instrument matches a target steam flow rate of the boiler, wherein

the control step controls the feeder by calculating the operation amount of the feeder calculated in the operation amount calculation step and the adjustment value of the operation amount of the feeder determined in the decision step,

the method further comprises

a storage step of storing a relationship between the moisture content in the waste and a calorific value in the waste,

in the decision step, the calorific value change in the waste is decided based on the moisture content in the waste measured in the measurement step, and a relationship between the moisture content in the waste and the calorific value in the waste stored in the storage step,

the method further comprises

a calorific value calculation step of calculating a calorific value from the steam flow rate measured by the steam flow rate measuring instrument; and

an update step of updating the relationship between the moisture content in the waste and the calorific value in the waste stored in the storage step from the calorific value calculated in the calorific value calculation step and the moisture content in the waste measured in the measurement step.