[DESCRIPTION]

[TITLE OF INVENTION]

COMBUSTION EQUIPMENT, COMPUTATION METHOD, AND PROGRAM

[Technical Field]

[0001]

The present disclosure relates to combustion equipment, a computation method, and a program.

Priority is claimed on Japanese Patent Application No. 2019-217297, filed November 29, 2019, the content of which is incorporated herein by reference.

[Background Art]

[0002]

Patent Document 1 discloses a technique in which the oxygen content of combustion air supplied below a combustion stoker and a post-combustion stoker is controlled by the layer thickness and the burn-up point of the combustion stoker and the ember combustion completion point of the post-combustion stoker to perform stable incineration processing of waste.

[0003]

Patent Document 2 discloses a technique of determining the exhaust gas concentration of a specific component generated in a part or the whole of a post-combustion zone and of deriving a combustion speed of garbage from the detected exhaust gas concentration to obtain the amount of unburned garbage from the derived combustion speed and the amount of supplied combustion air at that time.

[Citation List]

[Patent Documents]

[0004]

[Patent Document 1]

Japanese Patent No. 3618668

[Patent Document 2]

Japanese Unexamined Patent Application, First Publication No. H6-288529

[Summary of Invention]

[Technical Problem]

[0005]

For waste or solid fuel, such as biomass, to be put into combustion equipment, an unburned portion thereof changes when a type, component, calorific value, fixed carbon ratio, or the like thereof changes. In order to operate the combustion equipment efficiently, it is desired to control the solid fuel to burn up at the end of a post-combustion stage of the combustion equipment. However, it is difficult to directly measure the unburned portion of the solid fuel in real time.

The present disclosure has been made to solve the above problems, and an object of the present disclosure is to provide combustion equipment, a computation method, and a program.

[Solution to Problem]

[0006]

Combustion equipment according to the present disclosure including a furnace body that has a drying stage, a combustion stage, and a post-combustion stage disposed in a conveying direction and defines a processing space where a material to be incinerated is subjected to each of drying, combustion, and post-combustion of the material by being conveyed in the conveying direction includes a temperature measurement unit configured to measure the temperature of the material to be incinerated in the vicinity of a burn-up point, which is an end of flame due to the combustion on a

stage side in the conveying direction, and a computation unit configured to compute a proportion of an unburned portion in the material to be incinerated after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[0007]

A computation method according to the present disclosure includes, in combustion equipment including a furnace body that has a drying stage, a combustion stage, and a post-combustion stage disposed in a conveying direction and defines a processing space where a material to be incinerated is subjected to each of drying, combustion, and post-combustion by being conveyed in the conveying direction, a step of measuring the temperature of the material to be incinerated in the vicinity of a burn-up point, which is an end of flame due to the combustion on a stage side in the conveying direction, and a step of computing a proportion of an unburned portion in the material to be incinerated after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[0008]

A program according to the present disclosure causing a computer of combustion equipment including a furnace body that has a drying stage, a combustion stage, and a post-combustion stage disposed in a conveying direction and defines a processing space where a material to be incinerated is subjected to each of drying, combustion, and post-combustion by being conveyed in the conveying direction to execute a step of measuring the temperature of the material to be incinerated in the vicinity of the burn-up point, which is an end of flame due to the combustion on a stage side in the conveying direction, and a step of computing a proportion of an unburned

portion in the material to be incinerated after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[Advantageous Effects of Invention]

[0009]

According to the combustion equipment, computation method, and program of the present disclosure, it is possible to appropriately maintain the proportion of the unburned portion in the material to be incinerated, which is incinerated by the combustion equipment, to realize stable combustion.

[Brief Description of Drawings]

[0010]

Fig. 1 is a diagram showing a configuration of combustion equipment according to an embodiment of the present disclosure.

Fig. 2 is a schematic block diagram showing a configuration of a control device according to the embodiment of the present disclosure.

Fig. 3 is a flowchart showing an operation of the combustion equipment according to the embodiment of the present disclosure.

Fig. 4 is a flowchart showing the operation of the combustion equipment according to the embodiment of the present disclosure.

Fig. 5 is a schematic block diagram showing a configuration of a control device according to an embodiment of the present disclosure.

Fig. 6 is a schematic block diagram showing a configuration of a computer according to at least one embodiment.

[Description of Embodiments]

[0011]

<First Embodiment>

<<Combustion Device Configuration>>

Hereinafter, a configuration of combustion equipment 100 according to a first embodiment will be described. The combustion equipment 100 according to the first embodiment is equipment to perform incineration processing of waste as a material to be incinerated 400. A garbage incineration stoker furnace and a biomass fluidized bed boiler are exemplary examples of the combustion equipment 100. The combustion equipment 100 according to the first embodiment is the garbage incineration stoker furnace.

[0012]

Fig. 1 is a diagram showing the configuration of the combustion equipment 100 according to the first embodiment. The combustion equipment 100 includes a stoker furnace 1, an exhaust heat recovery boiler 8, a cooling tower 9, a dust collector 11, a chimney 12, and a control device 300.

[0013]

The stoker furnace 1 is a furnace that combusts the material to be incinerated 400 while conveying the material. The waste and biomass are exemplary examples of the material to be incinerated 400. The material to be incinerated 400 in Fig. 1 is the waste. Exhaust gas is generated from the stoker furnace 1 as the material to be incinerated 400 is combusted by the stoker furnace 1. This exhaust gas is sent to the exhaust heat recovery boiler 8 provided in an upper part of the stoker furnace 1.

[0014]

The exhaust heat recovery boiler 8 heats water by exchanging heat between the exhaust gas and the water to generate steam. This steam is used in external equipment (not shown). The exhaust gas that has passed through the exhaust heat recovery boiler 8

is cooled by the cooling tower 9 and then sent to the dust collector 11. After soot and dust are removed by the dust collector 11, the exhaust gas is discharged into the atmosphere through the chimney 12.

[0015]

Next, a configuration of the stoker furnace 1 will be described. As shown in Fig. 1, the stoker furnace 1 includes a furnace body 10, a fire furnace 7 extending upward from the furnace body 10, a hopper 3 that temporarily stores the material to be incinerated 400, a feeder 31 configured to supply the material to be incinerated 400 from the hopper 3 into the furnace body 10, and a stoker 6 provided at the bottom part of the furnace body 10. Further, the stoker furnace 1 includes a discharge chute 13 that discharges the material to be incinerated 400 that has been incinerated to the outside, a wind box 2 provided below the stoker 6, a clinker roller 210 that moves the material to be incinerated 400 to the discharge chute 13, and a camera 220 that captures an image of a processing space V of the furnace body 10. Further, the stoker furnace 1 includes a blower B1 that sends air to a primary air line L1 and a secondary air line L2, the primary air line L1 that supplies air to the wind box 2, and the secondary air line L2 that supplies air to the fire furnace 7.

[0016]

The stoker 6 is composed of a plurality of grate bars 61. The grate bar 61 includes a fixed grate bar 61A and a movable grate bar 61B. The fixed grate bar 61A is the grate bar 61 that is fixed. The movable grate bar 61B is the grate bar 61 that agitates the material to be incinerated 400 on the grate bar 61 with operation in a conveying direction Da and a -Da direction at a constant speed. The above -Da direction is a direction opposite to the conveying direction Da.

[0017]

The processing space V for combusting the material to be incinerated 400 is formed inside the furnace body 10. In this processing space V, the material to be incinerated 400 is conveyed by the stoker 6 in the conveying direction Da from the feeder 31 toward the discharge chute 13. The material to be incinerated 400 that has been combusted is discharged into the outside through the discharge chute 13. In the present embodiment, the stoker 6 is provided horizontally. On the other hand, the stoker 6 according to another embodiment may be provided so as to be inclined with respect to a horizontal plane.

[0018]

The furnace body 10 is designed to be divided into a drying stage 21, a combustion stage 22, and a post-combustion stage 23 in this order from an upstream side in the conveying direction Da. The drying stage 21 is a section where the material to be incinerated 400 supplied from the hopper 3 is dried prior to the combustion. The combustion stage 22 and the post-combustion stage 23 are sections where the material to be incinerated 400 in a dry state is combusted. In the combustion stage 22, flame F is generated by pyrolysis gas generated from the material to be incinerated 400. In the post-combustion stage 23, since fixed carbon of the material to be incinerated 400 is combusted, the flame F is not generated. That is, the flame F caused by the combustion is mainly formed above the combustion stage 22.

[0019]

The fire furnace 7 extends upward from an upper part of the furnace body 10. The exhaust gas in the processing space V is sent to the exhaust heat recovery boiler 8 through the fire furnace 7. The primary air line L1 connects the blower B1 and the wind box 2. The blower B1 is driven to supply the air to the wind box 2 through the primary air line L1. The wind box 2 supplies the air into the processing space V. The

secondary air line L2 connects the blower B1 and the inside of the fire furnace 7. Combustion air is supplied into the fire furnace 7 through the secondary air line L2. The wind box 2 forms a bottom surface of the processing space V. A plurality of wind boxes 2 are disposed in the conveying direction Da.

[0020]

The clinker roller 210 rotates to move the material to be incinerated 400 from the post-combustion stage 23 to the discharge chute 13. The clinker roller 210 rotates for each time set by the control device 300. The camera 220 images the material to be incinerated 400 in the vicinity of a first half of the post-combustion stage 23 and the periphery of the material to be incinerated 400. A region of a front half of the post-combustion stage 23 is an exemplary example of the first half of the post-combustion stage 23. That is, a region related to a front one wind box 2 of two wind boxes 2 related to the post-combustion stage 23 is an exemplary example of the first half of the post-combustion stage 23.

[0021]

As described above, the flame F caused by the combustion is formed above the combustion stage 22 and is not generated in the post-combustion stage 23. Therefore, it can be said that the first half of the post-combustion stage 23 is in the vicinity of an end of the flame F on a stage side in the conveying direction. Hereinafter, the end of the flame F on the stage side in the conveying direction is also referred to as a burn-up point Z. It can be said that the burn-up point Z is a point at which the generation of the pyrolysis gas due to the heating of the material to be incinerated 400 is completed. The burn-up point Z may change depending on an environment in which the combustion equipment 100 is placed and a combustion situation of the material to be incinerated 400. Therefore, the burn-up point Z is set to a predetermined range including a boundary point

between the combustion stage 22 and the post-combustion stage 23 or a predetermined range including the end of the flame F on the stage side in the conveying direction. Image data generated by the camera 220 when the camera 220 images the periphery of the material to be incinerated 400 includes a wall surface of the furnace body 10 that defines the processing space V and luminous flame generated from the material to be incinerated 400. A camera including a visible camera and an infrared camera is an exemplary example of the camera 220. The camera 220 may include a hyperspectral camera instead of the infrared camera.

[0022]

The control device 300 controls the stoker 6, the blower B1, and the clinker roller 210. Fig. 2 is a schematic block diagram showing a configuration of the control device 300. The control device 300 includes an acquisition unit 305, a temperature measurement unit 310, a length measurement unit 320, a height measurement unit 330, a computation unit 340, and a control unit 350. The control device 300 is connected to the combustion equipment 100 wiredly or wirelessly.

[0023]

The acquisition unit 305 acquires the image data from the camera 220.

The temperature measurement unit 310 measures the temperature of the material to be incinerated 400 in the vicinity of a front stage of the post-combustion stage 23 based on the image data acquired by the acquisition unit 305. The vicinity of a place to be the burn-up point Z of the material to be incinerated 400 in a case where the material to be incinerated 400 is incinerated by using the combustion equipment 100 is an exemplary example of the vicinity of the above front stage. That is, the temperature of the material to be incinerated 400 in the predetermined range including the boundary point between the combustion stage 22 and the post-combustion stage 23 or the

predetermined range including the end of the flame F on the stage side in the conveying direction is an exemplary example of the temperature of the material to be incinerated 400 in the vicinity of the front stage. Further, an average temperature of the material to be incinerated 400 in the front stage of the post-combustion stage 23 is an exemplary example of the temperature of the material to be incinerated 400 in the vicinity of the front stage. Specifically, the temperature measurement unit 310 measures the temperature by performing the following operation.

[0024]

The temperature measurement unit 310 receives the image data acquired by the acquisition unit 305 from the infrared camera or the hyperspectral camera of the camera 220. In the received image data, the temperature measurement unit 310 divides a preset portion in the region in the vicinity of the first half of the post-combustion stage 23, which is the region in the vicinity of the burn-up point Z, into each zone and normalizes brightness for each zone. Thereafter, the temperature measurement unit 310 combines the brightness for each zone with temperature information associated with the brightness and the temperature to specify the temperature for each zone. The temperature measurement unit 310 specifies a highest temperature among the temperatures of the zones or an average temperature of the temperatures of the zones as the temperature of the material to be incinerated 400 and measures the temperature of the material to be incinerated 400.

[0025]

The length measurement unit 320 measures a burn-up length based on the image data acquired by the acquisition unit 305. The burn-up length is a length from a boundary between the feeder 31 and the drying stage 21 to the burn-up point Z. The material to be incinerated 400 changes from gas combustion to solid combustion at the

burn-up point Z as a boundary. Specifically, the length measurement unit 320 measures the burn-up length by the following operation.

[0026]

The length measurement unit 320 receives the image data acquired by the acquisition unit 305 from the camera 220. Thereafter, the length measurement unit 320 binarizes the brightness of the received image data with a preset threshold value. The length measurement unit 320 specifies, in a case where values of the binarized image data are arranged in the order of the conveying direction Da, points at which the values change as points related to a boundary of the luminous flame of the flame F. The length measurement unit 320 computes an average value of the points related to the boundary of the luminous flame of the flame F and specifies the computed value as the burn-up point Z. The length measurement unit 320 computes a length from a contact point between the feeder 31 and the drying stage 21 to the burn-up point Z to measure the burn-up length.

[0027]

The height measurement unit 330 acquires the image data from the camera 220 and measures a height of a surface of the material to be incinerated 400 in the vicinity of the first half of the post-combustion stage 23. The height is a relative height of the surface of the material to be incinerated 400 with a wall surface of the furnace body 10 that defines the processing space V as reference. Specifically, the height measurement unit 330 measures the height of the surface of the material to be incinerated 400 by the following operation.

[0028]

The height measurement unit 330 receives the image data acquired by the acquisition unit 305 from the infrared camera or the hyperspectral camera of the camera

220. The height measurement unit 330 combines, among the received image data, the surface of the material to be incinerated 400 specified by a preset threshold value with the reference of the wall surface of the processing space V to measure the height of the surface thereof.

[0029]

The computation unit 340 computes a proportion of an unburned portion in the material to be incinerated 400 after the post-combustion. The proportion of the unburned portion is a value obtained by dividing a weight of char (fixed carbon) contained in the material to be incinerated 400 after the post-combustion by a value obtained by adding the weight of char contained in the material to be incinerated 400 after the post-combustion and a weight of carbon contained in the material to be incinerated 400. Specifically, the computation unit 340 substitutes the data acquired from the temperature measurement unit 310, the length measurement unit 320, and the height measurement unit 330 into the following equation (1) to compute the proportion of the unburned portion.

[0030]

$$\text{Proportion of unburned portion} = C + \alpha X_1 - \beta X_2 + \gamma X_3 \ldots (1)$$

[0031]

In the above formula 1, a reference value C is a preset reference value. A coefficient α, a coefficient β, and a coefficient γ are preset coefficient values. The reference value C, the coefficient α, the coefficient β, and the coefficient γ are set in advance by actually measuring the proportion of the unburned portion in the material to be incinerated 400 before using the combustion equipment. Further, the reference value C, the coefficient α, the coefficient β, and the coefficient γ may change depending on the environment around the combustion equipment 100, components of the material to be

incinerated 400, and the like.

[0032]

X_1 is a value obtained by subtracting the burn-up length measured by the length measurement unit 320 from a preset reference burn-up length. X_2 is a value obtained by subtracting the height measured by the height measurement unit 330 from a preset reference height. X_3 is a value obtained by subtracting the temperature measured by the temperature measurement unit 310 from a preset reference temperature value.

[0033]

The control unit 350 controls the combustion equipment 100 such that the proportion of the unburned portion computed by the computation unit 340 is within a preset range. A range in which an upper limit value is set to a value obtained by adding a fluctuation value specified by a user of the combustion equipment 100 in consideration of a fluctuation in the operation of the combustion equipment 100 to a target unburned portion proportion, which is a proportion of the unburned portion specified to be optimal for a stable operation of the combustion equipment 100, and a lower limit value is set to a value obtained by subtracting the fluctuation value specified by the user of the combustion equipment 100 in consideration of the fluctuation in the operation of the combustion equipment 100 from the target unburned portion proportion, which is the proportion of the unburned portion specified by the user of the combustion equipment 100 to be optimal for the stable operation of the combustion equipment 100, is an exemplary example within the preset range. A proportion necessary to burn up the fixed carbon in the material to be incinerated 400 when the material to be incinerated 400 reaches a rearmost end of the post-combustion stage 23 is an exemplary example of the target unburned portion proportion.

[0034]

Specifically, the control unit 350 controls the clinker roller 210, the blower B1, the grate bar 61, and the wind box 2 such that an operation interval of the clinker roller 210, a proportion of the air introduced into the post-combustion stage 23 in the air introduced into the drying stage 21, the combustion stage 22, and the post-combustion stage 23, an operation speed of the grate bar 61, and the amount of air introduced into the wind box 2 change.

[0035]

In a case where the operation interval of the clinker roller 210 increases, the residence time of the material to be incinerated 400 in the furnace body 10 increases. Accordingly, the combustion time of the material to be incinerated 400 becomes longer. Therefore, the proportion of the unburned portion in the material to be incinerated 400 decreases. In a case where the operation interval of the clinker roller 210 decreases, the residence time of the material to be incinerated 400 in the furnace body decreases. Accordingly, the combustion time of the material to be incinerated 400 is shortened. Therefore, the proportion of the unburned portion in the material to be incinerated 400 increases.

[0036]

Further, in a case where the proportion of the air introduced into the post-combustion stage 23 in the air introduced into the drying stage 21, the combustion stage 22, and the post-combustion stage 23 increases, the post-combustion to eliminate the fixed carbon of the material to be incinerated 400 is performed more strongly based on a large amount of air. Therefore, the proportion of the unburned portion in the material to be incinerated 400 decreases. In a case where the proportion of the air introduced into the post-combustion stage 23 in the air introduced into the drying stage 21, the combustion stage 22, and the post-combustion stage 23 decreases, the post-combustion to

eliminate the fixed carbon of the material to be incinerated 400 is performed more weakly based on a small amount of air. Therefore, the proportion of the unburned portion in the material to be incinerated 400 increases.

[0037]

Further, in a case where the operation speed of the movable grate bar 61B of the grate bar 61 increases, the material to be incinerated 400 is agitated more strongly. Therefore, the proportion of the unburned portion in the material to be incinerated 400 decreases. In a case where the operation speed of the movable grate bar 61B of the grate bar 61 decreases, the material to be incinerated 400 is agitated more weakly. Therefore, the proportion of the unburned portion in the material to be incinerated 400 increases.

[0038]

Further, in a case where the amount of air introduced into the wind box 2 related to the drying stage 21, the combustion stage 22, and the post-combustion stage 23 increases, the material to be incinerated 400 is incinerated more strongly based on a larger amount of air. Therefore, the proportion of the unburned portion in the material to be incinerated 400 decreases. In a case where the amount of air introduced into the wind box 2 related to the drying stage 21, the combustion stage 22, and the post-combustion stage 23 decreases, the material to be incinerated 400 is incinerated more weakly based on a smaller amount of air. Therefore, the proportion of the unburned portion in the material to be incinerated 400 increases.

[0039]

<<Operation of Computing Proportion of Unburned Portion in Combustion Equipment>>

Hereinafter, an operation of computing the proportion of the unburned portion of

the combustion equipment 100 will be described. Fig. 3 is a flowchart showing the operation of computing the proportion of the unburned portion of the combustion equipment 100 according to the first embodiment.

[0040]

The camera 220 images the processing space V to acquire the image data of the material to be incinerated 400 and the periphery of the material to be incinerated 400 (step S1). Specifically, the visible camera and the infrared camera of the camera 220 image the wall surface defining the material to be incinerated 400 and the processing space V.

The acquisition unit 305 acquires the image data imaged by the camera 220 in step S1.

[0041]

The temperature measurement unit 310 measures the temperature of the material to be incinerated 400 based on the image data acquired by the acquisition unit 305 in step S2 (step S3). For example, the temperature measurement unit 310 receives the image data acquired by the acquisition unit 305 in step S2. In the received image data, the temperature measurement unit 310 divides the preset portion in the region in the vicinity of the first half of the post-combustion stage 23, which is the region in the vicinity of the burn-up point Z, into each zone and normalizes brightness for each zone. Thereafter, the temperature measurement unit 310 combines the brightness for each zone with temperature information associated with the brightness and the temperature to specify the temperature for each zone. The temperature measurement unit 310 specifies the highest temperature among the temperatures of the zones or the average temperature of the temperatures of the zones as the temperature of the material to be incinerated 400 and measures the temperature of the material to be incinerated 400.

[0042]

The length measurement unit 320 measures the burn-up length based on the image data acquired by the acquisition unit 305 in step S2 (step S4). For example, the length measurement unit 320 receives the image data acquired by the acquisition unit 305 in step S2. Thereafter, the length measurement unit 320 binarizes the brightness of the received image data with the preset threshold value. The length measurement unit 320 specifies, in a case where the values of the binarized image data are arranged in the order of the conveying direction Da, the points at which the values change as points related to the boundary of the luminous flame of the flame F. The length measurement unit 320 computes the average value of the points related to the boundary of the luminous flame of the flame F and specifies the computed value as the burn-up point Z. The length measurement unit 320 computes the length from the contact point between the feeder 31 and the drying stage 21 to the burn-up point Z to measure the burn-up length.

[0043]

The height measurement unit 330 measures the height of the surface of the material to be incinerated 400 based on the image data acquired by the acquisition unit 305 in step S2 (step S5). For example, the height measurement unit 330 receives the image data acquired by the acquisition unit 305 from the infrared camera or the hyperspectral camera of the camera 220. The height measurement unit 330 combines, among the received image data, the surface of the material to be incinerated 400 specified by the preset threshold value with the reference of the wall surface of the processing space V to measure the height of the surface thereof.

[0044]

The computation unit 340 computes the proportion of the unburned portion based on the temperature measured in step S2, the burn-up length measured in step S3,

and the height measured in step S4 (step S6).

[0045]

By the above operation, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion. Accordingly, the user of the combustion equipment 100 can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0046]

<<Operation of Controlling Combustion Equipment>>

Hereinafter, an operation of controlling the combustion equipment 100 will be described. Fig. 4 is a flowchart showing the operation of controlling combustion equipment 100 according to the first embodiment.

[0047]

The combustion equipment 100 computes the proportion of the unburned portion by the operations from step S1 to step S5 described above. In a case where the computed proportion of the unburned portion is within the preset range (step S11: YES), the operation related to the control of the combustion equipment 100 ends. On the other hand, in a case where the computed proportion of the unburned portion is not within the preset range (step S11: NO), the control unit 350 performs control such that the operation interval of the clinker roller 210 changes (step S12). That is, the control unit 350 sends a signal to the clinker roller 210 to change the operation interval of the clinker roller 210. For example, in a case where the proportion of the unburned portion is equal to or higher than the upper limit value in the preset range, the control unit 350 controls to increase the operation interval of the clinker roller 210. In a case where the proportion of the unburned portion is equal to or less than the lower limit value of the preset range, the

control unit 350 controls to decrease the operation interval of the clinker roller 210.

[0048]

After step S12, the combustion equipment 100 repeats the operations from step S1 to step S5 again to compute the proportion of the unburned portion. Thereafter, in a case where the computed proportion of the unburned portion is within the preset range (step S13: YES), the operation related to the control of the combustion equipment 100 ends. On the other hand, in a case where the computed proportion of the unburned portion is not within the preset range (step S13: NO), the control unit 350 controls the proportion of the air introduced into the post-combustion stage 23 (step S14). That is, the control unit 350 sends a signal to the blower B1 to control the proportion of the air introduced into the post-combustion stage 23 by the primary air line L1. For example, in a case where the proportion of the unburned portion is equal to or higher than the upper limit value of the preset range, the control unit 350 performs control such that the proportion of the air introduced into the post-combustion stage 23 increases. On the other hand, when the proportion of the unburned portion is equal to or less than the lower limit value in the preset range, the control unit 350 performs control such that the proportion of the air introduced into the post-combustion stage 23 decreases.

[0049]

After step S14, the combustion equipment 100 repeats the operations from step S1 to step S5 again to compute the proportion of the unburned portion. Thereafter, in a case where the computed proportion of the unburned portion is within the preset range (step S15: YES), the operation related to the control of the combustion equipment 100 ends. On the other hand, in a case where the computed proportion of the unburned portion is not within the preset range (step S15: NO), the control unit 350 controls the operation speed of the grate bar 61 (step S16). That is, the control unit 350 sends a

signal to the actuator that operates the movable grate bar 61B to control the operation speed of the movable grate bar 61B. For example, in a case where the proportion of the unburned portion is equal to or higher than the upper limit value of the preset range, the control unit 350 performs control such that the operation speed of the movable grate bar 61B increases. On the other hand, in a case where the proportion of the unburned portion is equal to or less than the lower limit value in the preset range, the control unit 350 performs control such that the operation speed of the movable grate bar 61B decreases.

[0050]

After step S16, the combustion equipment 100 repeats the operations from step S1 to step S5 again to compute the proportion of the unburned portion. Thereafter, in a case where the computed proportion of the unburned portion is within the preset range (step S17: YES), the operation related to the control of the combustion equipment 100 ends. On the other hand, in a case where the computed proportion of the unburned portion is not within the preset range (step S17: NO), the control unit 350 controls the amount of air introduced into the wind box 2 (step S18). That is, the control unit 350 sends a signal to the blower B1 to control the amount of air introduced into the wind box 2. For example, in a case where the proportion of the unburned portion is equal to or higher than the upper limit value of the preset range, the control unit 350 performs control such that the amount of air introduced into the wind box 2 increases. On the other hand, in a case where the proportion of the unburned portion is equal to or less than the lower limit value in the preset range, the control unit 350 performs control such that the amount of air introduced into the wind box 2 decreases.

[0051]

After step S18, the combustion equipment 100 repeats the operations from step

S1 to step S5 again to compute the proportion of the unburned portion. Thereafter, in a case where the computed proportion of the unburned portion is within the preset range (step S19: YES), the operation related to the control of the combustion equipment 100 ends. On the other hand, in a case where the computed proportion of the unburned portion is not within the preset range (step S19: NO), the processing returns to step S12 again, and the control unit 350 performs control such that the operation interval of the clinker roller 210 changes (step S12).

[0052]

The combustion equipment 100 is controlled by the above operation, based on the computed proportion of the unburned portion, such that the proportion of the unburned portion is within the preset range. Therefore, the user of the combustion equipment 100 can appropriately maintain the proportion of the unburned portion in the material to be incinerated 400 to perform stable combustion in the combustion equipment 100.

[0053]

The operation of controlling the combustion equipment 100 is not limited to the above operation. For example, the order of the control of the clinker roller 210, the control of the proportion of air, the control of the operation speed of the grate bar 61, and the control of the amount of air is not limited to the order in the above operation, but may be an operation related to a different order. Further, among the control of the clinker roller 210, the control of the proportion of air, the control of the operation speed of the grate bar 61, and the control of the amount of air, a plurality of pieces of control may be performed at the same time. Further, among the control of the clinker roller 210, the control of the proportion of air, the control of the operation speed of the grate bar 61, and the control of the amount of air, only the operation related to one piece of control may be

performed a plurality of times. Further, among the control of the clinker roller 210, the control of the proportion of air, the control of the operation speed of the grate bar 61, and the control of the amount of air, only one piece of control may be performed.

[0054]

<<Action/Effect>>

The combustion equipment 100 according to the present disclosure including the furnace body 10 that has the drying stage 21, the combustion stage 22, and the post-combustion stage 23 disposed in the conveying direction and defines the processing space V where the material to be incinerated 400 is subjected to each of the drying, combustion, and post-combustion being conveyed in the conveying direction Da includes the temperature measurement unit 310 configured to measure the temperature of the material to be incinerated 400 in the vicinity of the burn-up point Z, which is the end of the flame due to the combustion on the stage side in the conveying direction Da and the computation unit 340 configured to compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion based on the temperature difference obtained by subtracting the measured temperature value from the preset reference temperature value.

[0055]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion, and the user of the combustion equipment 100 can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0056]

Further, the combustion equipment 100 includes the control unit 350 configured

to control the combustion equipment 100 such that the proportion of the unburned portion is within the preset range.

[0057]

Accordingly, the combustion equipment 100 is controlled by the above operation, based on the computed proportion of the unburned portion, such that the proportion of the unburned portion is within the preset range. Therefore, the user of the combustion equipment 100 can appropriately maintain the proportion of the unburned portion in the material to be incinerated 400 to perform stable combustion in the combustion equipment 100.

[0058]

Further, the furnace body 10 of the combustion equipment 100 has the clinker roller 210 that moves the material to be incinerated 400 from the post-combustion stage 23, the wind box 2 that introduces the air into each of the drying stage 21, the combustion stage 22, and the post-combustion stage 23, and the grate bar 61 that conveys the material to be incinerated 400 in the conveying direction Da. The control unit 350 controls at least one of the operation interval of the clinker roller 210, the proportion of the air introduced into the post-combustion stage 23 in the air introduced into the drying stage 21, the combustion stage 22, and the post-combustion stage 23, the operation speed of the grate bar 61, and the amount of air introduced into the wind box 2.

[0059]

Accordingly, the combustion equipment 100 can maintain the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, within a certain range by controlling the amount of air and the distribution of air introduced into the clinker roller 210 and the wind box 2 and the operation speed of the grate bar 61. Therefore, the user of the combustion equipment

100 can appropriately maintain the proportion of the unburned portion in the material to be incinerated 400 to perform stable combustion.

[0060]

Further, the combustion equipment 100 includes the feeder 31 configured to supply the material to be incinerated 400 to the drying stage 21 and the length measurement unit 320 configured to measure the burn-up length, which is the length from the contact point between the feeder 31 and the drying stage 21 to the burn-up point Z of the material to be incinerated 400. The computation unit 340 computes the proportion of the unburned portion based on the temperature difference obtained by subtracting the measured temperature value from the reference temperature value and the value obtained by subtracting the burn-up length from the reference burn-up length.

[0061]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion by measuring the burn-up length, and the user of the combustion equipment 100 can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0062]

Further, the combustion equipment 100 includes the height measurement unit 330 configured to measure the height of the surface of the material to be incinerated 400 in the vicinity of the first half of the post-combustion stage 23. The computation unit 340 computes the proportion of the unburned portion based on the temperature difference obtained by subtracting the measured temperature value from the reference temperature value, the value obtained by subtracting the burn-up length from the reference burn-up length, and the value obtained by subtracting the height from the reference height.

[0063]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion by measuring the height of the surface of the material to be incinerated 400, and the user of the combustion equipment 100 can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0064]

<Second Embodiment>

Hereinafter, the combustion equipment 100 according to a second embodiment will be described. A configuration of the combustion equipment 100 according to the second embodiment is the same as that of the combustion equipment 100 according to the first embodiment. The computation unit 340 according to the second embodiment is different from the computation unit 340 according to the first embodiment, and the proportion of the unburned portion is computed based on a proportion of the unburned portion computed in advance without computing the proportion of the unburned portion using the formula.

[0065]

For example, the computation unit 340 combines the burn-up length measured by the length measurement unit 320, the height measured by the height measurement unit 330, and the temperature measured by the temperature measurement unit 310 with a table in which the burn-up length, the height, the temperature, and the proportion of the unburned portion are associated with each other to compute the proportion of the unburned portion.

[0066]

Accordingly, the computation unit 340 computes the proportion of the unburned portion in the material to be incinerated 400 using the proportion of the unburned portion computed in advance. Therefore, the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, can be computed, and the user of the combustion equipment 100 can grasp the proportion of the unburned portion in real time.

[0067]

<Third Embodiment>

Hereinafter, the combustion equipment 100 according to a third embodiment will be described. The length measurement unit 320, the height measurement unit 330, and the computation unit 340 among the configurations of the control device 300 of the combustion equipment 100 according to the first embodiment are not included in a configuration of the control device 300 of the combustion equipment 100 according to the third embodiment. The control device 300 of the combustion equipment 100 according to the third embodiment controls the combustion equipment 100 by using a value measured by the temperature measurement unit 310 or the like without computing the proportion of the unburned portion in the material to be incinerated 400.

[0068]

Fig. 5 is a schematic block diagram showing the configuration of the control device 300 according to the third embodiment. The control device 300 includes the temperature measurement unit 310 and the control unit 350.

The camera 220 provided in the combustion equipment 100 according to the third embodiment may include a visible camera.

[0069]

The control unit 350 controls the combustion equipment 100 such that the

temperature value measured by the temperature measurement unit 310 is within a preset range. For example, in a case where the temperature value measured by the temperature measurement unit 310 is higher than an upper limit value in the preset range, the control unit 350 performs control such that the operation interval of the clinker roller 210, the proportion of air introduced into the post-combustion stage 23, the operation speed of the grate bar 61, or the amount of air introduced into the wind box 2 is increased.

[0070]

Further, in a case where the temperature value measured by the temperature measurement unit 310 is lower than a lower limit value in the preset range, the control unit 350 performs control such that the operation interval of the clinker roller 210, the proportion of air introduced into the post-combustion stage 23, the operation speed of the grate bar 61, or the amount of air introduced into the wind box 2 is decreased. That is, in the control device according to the first embodiment, the proportion of the unburned portion is obtained, and the control unit 350 controls the combustion equipment 100 based on the proportion of the unburned portion. However, in the combustion equipment 100 according to the third embodiment, the computation of the proportion of the unburned portion is omitted, and the control is performed based on the temperature measured by the temperature measurement unit 310.

[0071]

<<Action/Effect>>

The combustion equipment 100 according to the present disclosure including the furnace body 10 that has the drying stage 21, the combustion stage 22, and the post-combustion stage 23 disposed in the conveying direction Da and defines the processing space V where the material to be incinerated 400 is subjected to each of the drying, combustion, and post-combustion by being conveyed in the conveying direction Da

includes the temperature measurement unit 310 configured to measure the temperature of the material to be incinerated 400 in the vicinity of the burn-up point Z, which is the end of the flame due to the combustion on the stage side in the conveying direction Da and the control unit 350 configured to control the combustion equipment 100 such that the temperature value is within the preset range.

[0072]

Accordingly, the combustion equipment 100 controls the combustion equipment 100 using the measured temperature of the material to be incinerated 400. Therefore, the user of the combustion equipment 100 can appropriately maintain the proportion of the unburned portion in the material to be incinerated 400 to perform stable combustion.

[0073]

<Another Embodiment>

Although one embodiment has been described in detail with reference to the drawings, the specific configuration is not limited to the above, and various design changes and the like can be made.

[0074]

In the combustion equipment 100, direct measurement of a pyrolysis gas concentration of the material to be incinerated 400 may be performed instead of the measurement of the burn-up length by the length measurement unit 320. In this case, the computation unit 340 computes the proportion of the unburned portion using the measured concentration. The temperature may also be measured directly using a thermocouple.

[0075]

Further, the control unit 350 may control a device provided in the combustion equipment 100 to perform control such that the proportion of the unburned portion in the

material to be incinerated 400 changes, in addition to the example described in the first embodiment described above.

[0076]

The control is performed based on the temperature and height of the material to be incinerated 400 at the position of the first half of the post-combustion stage 23 defined in advance, but the present disclosure is not limited thereto. The burn-up point is specified, and then the temperature and height of the material to be incinerated 400 in the vicinity of the burn-up point are specified. The control may be performed based on the specified temperature and height thereof.

[0077]

Fig. 6 is a schematic block diagram showing a configuration of a computer according to at least one embodiment.

A computer 1100 includes a processor 1110, a main memory 1120, a storage 1130, and an interface 1140.

The control device 300 described above is mounted on the computer 1100. The operation of each of the above processing units is stored in the storage 1130 in the form of a program. The processor 1110 reads out the program from the storage 1130, expands the program into the main memory 1120, and executes the above processing according to the program. Further, the processor 1110 secures a storage region corresponding to each of the above storage units in the main memory 1120 according to the program.

[0078]

The program may be for realizing a part of functions exerted by the computer 1100. For example, the program may exert the function by a combination with another program already stored in the storage 1130 or a combination with another program

installed in another device. In another embodiment, the computer 1100 may include a custom large scale integrated circuit (LSI), such as a programmable logic device (PLD), in addition to or instead of the above configuration. A programmable array logic (PAL), a generic array logic (GAL), a complex programmable logic device (CPLD), and a field programmable gate array (FPGA) are exemplary examples of the PLD. In this case, a part or all of the functions realized by the processor 1110 may be realized by the integrated circuit.

[0079]

A magnetic disk, a magneto-optical disk, and a semiconductor memory are exemplary examples of the storage 1130. The storage 1130 may be an internal medium directly connected to a bus of the computer 1100 or an external medium connected to the computer through the interface 1140 or a communication line. In a case where this program is distributed to the computer 1100 by a communication line, the computer 1100 that receives the distributed program may expand the program into the main memory 1120 and execute the above processing. In at least one embodiment, the storage 1130 is a non-temporary tangible storage medium.

[0080]

The program may be for realizing a part of the above functions. Further, the program may be a so-called difference file (difference program) that realizes the above functions in combination with another program already stored in the storage 1130.

[0081]

<Additional Notes>

(1) Combustion equipment 100 according to a first embodiment including a furnace body 10 that has a drying stage 21, a combustion stage 22, and a post-combustion stage 23 disposed in a conveying direction and defines a processing space V

where a material to be incinerated 400 is subjected to each of the drying, combustion, and post-combustion by being conveyed in the conveying direction Da includes a temperature measurement unit 310 configured to measure the temperature of the material to be incinerated 400 in the vicinity of a burn-up point Z, which is an end of flame due to the combustion on a stage side in the conveying direction Da, and a computation unit 340 configured to compute a proportion of an unburned portion in the material to be incinerated 400 after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[0082]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion, and the user of the combustion equipment 100 can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0083]

(2) The combustion equipment 100 further includes a control unit 350 configured to control the combustion equipment 100 such that the proportion of the unburned portion is within a preset range.

[0084]

Accordingly, the combustion equipment 100 is controlled by the above operation, based on the computed proportion of the unburned portion, such that the proportion of the unburned portion is within the preset range. Therefore, the user of the combustion equipment 100 can appropriately maintain the proportion of the unburned portion in the material to be incinerated 400 to perform stable combustion in the

combustion equipment 100.

[0085]

(3) The furnace body 10 of the combustion equipment 100 has a clinker roller 210 that moves the material to be incinerated 400 from the post-combustion stage 23, a wind box 2 that introduces air into each of the drying stage 21, the combustion stage 22, and the post-combustion stage 23, and a grate bar 61 that conveys the material to be incinerated 400 in the conveying direction Da. The control unit 350 controls at least one of an operation interval of the clinker roller 210, a proportion of the air introduced into the post-combustion stage 23 in the air introduced into the drying stage 21, the combustion stage 22, and the post-combustion stage 23, an operation speed of the grate bar 61, and the amount of air introduced into the wind box 2.

[0086]

Accordingly, the combustion equipment 100 can maintain the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, within a certain range by controlling the amount of air and the distribution of air introduced into the clinker roller 210 and the wind box 2 and the operation speed of the grate bar 61. Therefore, the user of the combustion equipment 100 can appropriately maintain the proportion of the unburned portion in the material to be incinerated 400 to perform stable combustion.

[0087]

(4) The combustion equipment 100 further includes a feeder 31 configured to supply the material to be incinerated 400 to the drying stage 21 and a length measurement unit 320 configured to measure a burn-up length, which is a length from a contact point between the feeder 31 and the drying stage 21 to the burn-up point Z of the material to be incinerated 400. The computation unit 340 computes the proportion of

the unburned portion based on the temperature difference obtained by subtracting the measured value of the temperature from the reference temperature value and a value obtained by subtracting the burn-up length from a reference burn-up length.

[0088]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion by measuring the burn-up length, and the user of the combustion equipment 100 can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0089]

(5) The combustion equipment 100 further includes a height measurement unit 330 configured to measure the height of a surface of the material to be incinerated 400 in the vicinity of a first half of the post-combustion stage 23. The computation unit 340 computes the proportion of the unburned portion based on the temperature difference obtained by subtracting the measured value of the temperature from the reference temperature value, a value obtained by subtracting the burn-up length from a reference burn-up length, and a value obtained by subtracting the height from a reference height.

[0090]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion by measuring the height of the surface of the material to be incinerated 400, and the user of the combustion equipment 100 can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0091]

(6) Combustion equipment 100 according to a third embodiment including the furnace body 10 that has the drying stage 21, the combustion stage 22, and the post-combustion stage 23 disposed in the conveying direction Da and defines the processing space V where the material to be incinerated 400 is subjected to each of the drying, combustion, and post-combustion by being conveyed in the conveying direction Da includes a temperature measurement unit 310 configured to measure the temperature of the material to be incinerated 400 in the vicinity of a burn-up point Z, which is an end of flame due to the combustion on a stage side in the conveying direction Da and a control unit 350 configured to control the combustion equipment 100 such that the measured value of the temperature is within a preset range.

[0092]

Accordingly, the combustion equipment 100 controls the combustion equipment 100 using the measured temperature of the material to be incinerated 400. Therefore, the user of the combustion equipment 100 can appropriately maintain the proportion of the unburned portion in the material to be incinerated 400 to perform stable combustion.

[0093]

(7) A computation method according to the present disclosure includes, in combustion equipment 100 including a furnace body 10 that has a drying stage 21, a combustion stage 22, and a post-combustion stage 23 disposed in a conveying direction Da and defines a processing space V where a material to be incinerated 400 is subjected to each of the drying, combustion, and post-combustion by being conveyed in the conveying direction Da, a step of measuring the temperature of the material to be incinerated 400 in the vicinity of a burn-up point Z, which is an end of flame due to the combustion on a stage side in the conveying direction Da, and a step of computing a proportion of an unburned portion in the material to be incinerated 400 after the post-

combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[0094]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion, and the user of the computation method can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[0095]

(8) A program according to the present disclosure causing a computer of combustion equipment 100 including a furnace body 10 that has a drying stage 21, a combustion stage 22, and a post-combustion stage 23 disposed in a conveying direction Da and defines a processing space V where a material to be incinerated 400 is subjected to each of the drying, combustion, and post-combustion by being conveyed in the conveying direction Da to execute a step of measuring the temperature of the material to be incinerated 400 in the vicinity of a burn-up point Z, which is an end of flame F due to the combustion on a stage side in the conveying direction, and a step of computing a proportion of an unburned portion in the material to be incinerated 400 after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[0096]

Accordingly, the combustion equipment 100 can compute the proportion of the unburned portion in the material to be incinerated 400 after the post-combustion, and the user of the program can grasp the proportion of the unburned portion in the material to be incinerated 400, which is incinerated by the combustion equipment 100, in real time.

[Industrial Applicability]

[0097]

The combustion equipment computes the proportion of the unburned portion in the material to be incinerated after the post-combustion based on the temperature difference obtained by subtracting the measured temperature value of the material to be incinerated from the reference temperature value. Accordingly, the user of the combustion equipment can grasp the proportion of the unburned portion in the material to be incinerated, which is incinerated by the combustion equipment, in real time.

[Reference Signs List]

[0098]

1: Stoker furnace

2: Wind box

3: Hopper

4: Gas circulation unit

6: Stoker

7: Fire furnace

8: Exhaust heat recovery boiler

9: Cooling tower

10: Furnace body

11: Dust collector

12: Chimney

13: Discharge chute

21: Drying stage

22: Combustion stage

23: Post-combustion stage

31: Feeder

61: Grate bar

61A: Fixed grate bar

61B: Movable grate bar

100: Combustion equipment

210: Clinker roller

220: Camera

300: Control device

305: Acquisition unit

310: Temperature measurement unit

320: Length measurement unit

330: Height measurement unit

340: Computation unit

350: Control unit

400: Material to be incinerated

1100: Computer

1110: Processor

1120: Main memory

1130: Storage

1140: Interface

L1: Primary air line

L2: Secondary air line

B1: Blower

F: Flame

Z: Burn-up point

[CLAIMS]

What is claimed is:

[Claim 1]

Combustion equipment including a furnace body that has a drying stage, a combustion stage, and a post-combustion stage disposed in a conveying direction and defines a processing space where a material to be incinerated is subjected to each of drying, combustion, and post-combustion by being conveyed in the conveying direction, the combustion equipment comprising:

a temperature measurement unit configured to measure a temperature of the material to be incinerated in the vicinity of a burn-up point, which is an end of flame due to the combustion on a stage side in the conveying direction; and

a computation unit configured to compute a proportion of an unburned portion in the material to be incinerated after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[Claim 2]

The combustion equipment according to Claim 1, further comprising:

a control unit configured to control the combustion equipment such that the proportion of the unburned portion is within a preset range.

[Claim 3]

The combustion equipment according to Claim 2,

wherein the furnace body has a clinker roller that moves the material to be incinerated from the post-combustion stage, a wind box that introduces air into each of the drying stage, the combustion stage, and the post-combustion stage, and a grate bar that conveys the material to be incinerated in the conveying direction, and

the control unit controls at least one of an operation interval of the clinker roller, a proportion of the air introduced into the post-combustion stage in the air introduced into the drying stage, the combustion stage, and the post-combustion stage, an operation speed of the grate bar, and an amount of air introduced into the wind box.

[Claim 4]

The combustion equipment according to any one of Claims 1 to 3, further comprising:

a feeder configured to supply the material to be incinerated to the drying stage; and

a length measurement unit configured to measure a burn-up length, which is a length from a boundary between the feeder and the drying stage to the burn-up point,

wherein the computation unit computes the proportion of the unburned portion based on the temperature difference obtained by subtracting the measured value of the temperature from the reference temperature value and a value obtained by subtracting the burn-up length from a reference burn-up length.

[Claim 5]

The combustion equipment according to any one of Claims 1 to 4, further comprising:

a height measurement unit configured to measure a height of a surface of the material to be incinerated in the vicinity of the burn-up point,

wherein the computation unit computes the proportion of the unburned portion based on the temperature difference obtained by subtracting the measured value of the temperature from the reference temperature value, a value obtained by subtracting the burn-up length from a reference burn-up length, and a value obtained by subtracting the height from a reference height.

[Claim 6]

Combustion equipment including a furnace body that has a drying stage, a combustion stage, and a post-combustion stage disposed in a conveying direction and defines a processing space where a material to be incinerated is subjected to each of drying, combustion, and post-combustion by being conveyed in the conveying direction, the combustion equipment comprising:

a temperature measurement unit configured to measure a temperature of the material to be incinerated in the vicinity of a burn-up point, which is an end of flame due to the combustion on a stage side in the conveying direction; and

a control unit configured to control the combustion equipment such that a measured value of the temperature is within a preset range.

[Claim 7]

A computation method in combustion equipment including a furnace body that has a drying stage, a combustion stage, and a post-combustion stage disposed in a conveying direction and defines a processing space where a material to be incinerated is subjected to each of drying, combustion, and post-combustion by being conveyed in the conveying direction, the method comprising:

a step of measuring a temperature of the material to be incinerated in the vicinity of a burn-up point, which is an end of flame due to the combustion on a stage side in the conveying direction; and

a step of computing a proportion of an unburned portion in the material to be incinerated after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.

[Claim 8]

A program causing a computer of combustion equipment including a furnace body that has a drying stage, a combustion stage, and a post-combustion stage disposed in a conveying direction and defines a processing space where a material to be incinerated is subjected to each of drying, combustion, and post-combustion by being conveyed in the conveying direction to execute:

a step of measuring a temperature of the material to be incinerated in the vicinity of a burn-up point, which is an end of flame due to the combustion on a stage side in the conveying direction; and

a step of computing a proportion of an unburned portion in the material to be incinerated after the post-combustion based on a temperature difference obtained by subtracting a measured value of the temperature from a reference temperature value set in advance.