According to a first aspect of the present invention, there is provided an exhaust gas treatment device including: a dust collector into which an exhaust gas is introduced and that discharges a treated gas; a gas flow channel through which the exhaust gas is introduced into the dust collector; a first HCl detecting unit that detects an HCl concentration of the exhaust gas; a first SO_x detecting unit that detects an SO_x concentration of the exhaust gas; an alkali supply unit that supplies the gas flow channel with an alkaline agent including a Ca-based alkaline agent ~~and/~~or with an alkaline agent including a Ca-based alkaline agent and an Na-based alkaline agent at a weight which is determined by a control command based on the control command; and a controller that determines the weight of the alkaline agent and that sends out the control command, wherein the controller increases the weight of the Ca-based alkaline agent when an HCl/SO_x ratio is equal to or greater than a predetermined value and increases the weight of the Na-based alkaline agent when the HCl/SO_x ratio is equal to or less than the predetermined value, the HCl/SO_x ratio ~~determines the weight based on an HCl/SO_x ratio~~ which is calculated from the HCl concentration detected by the first HCl detecting unit and the SO_x concentration detected by the first SO_x detecting unit.

[0009]

According to this configuration, by optimizing the weight of the alkaline agent supplied to the exhaust gas based on the HCl/SO_x ratio, it is possible to achieve high exhaust gas treatment performance using a minimum amount of treatment agent and to operate the exhaust gas treatment device at a less treatment agent cost.

[0010]

~~In the exhaust gas treatment device, the controller may increase the weight of the Ca-based alkaline agent when the HCl/SO_x ratio is equal to or greater than a predetermined value and may increase the weight of the Na-based alkaline agent when~~

~~the HCl/SO_x ratio is equal to or less than the predetermined value.~~

~~[0011]~~

According to this configuration, the weight of the Na-based alkaline agent is increased only when the HCl/SO_x ratio is equal to or less than a predetermined value.

Accordingly, it is possible to further reduce an amount of Na-based alkaline agent used.

~~[0012]~~[0011]

The exhaust gas treatment device may further include: an H_2O detecting unit that detects an H_2O concentration of the exhaust gas; and a humidification means for humidifying the exhaust gas, and it is preferable that the controller humidify the exhaust gas using the humidification means and do not change the weight of the alkaline agent when the H_2O concentration is equal to or less than a predetermined value.

~~[0013]~~[0012]

According to this configuration, when the H_2O concentration is equal to or less than a predetermined value, only the humidification is performed and it is thus possible to treat the exhaust gas at a lower cost. By increasing the moisture concentration of the exhaust gas through humidification, it is possible to enhance reactivity of HCl and the like in the exhaust gas and to improve a demineralization rate.

~~[0014]~~[0013]

The exhaust gas treatment device may further include a temperature detecting unit that detects a temperature of the exhaust gas which is introduced into the dust collector, and the controller may increase the weight of the Na-based alkaline agent when the H_2O concentration is equal to or less than a predetermined value and the temperature of the exhaust gas is equal to or higher than a predetermined temperature.

~~[0015]~~[0014]

According to this configuration, when the H_2O concentration is low, the treatment is performed without supplying moisture to the exhaust gas. Accordingly, it is possible to treat the exhaust gas without lowering the temperature of the dust collector to be lower than a predetermined temperature.

~~[0016]~~[0015]

In the exhaust gas treatment device, it is preferable that the controller do not change the weight of the alkaline agent when the SO_x concentration of the exhaust gas is equal to or less than a predetermined value.

~~[0017]~~[0016]

According to this configuration, by performing control based on the HCl/SO_x ratio only when the SO_x concentration of the exhaust gas is equal to or greater than a predetermined value, a means for detecting the treated gas discharged from the dust collector can be omitted and it is thus possible to operate the exhaust gas treatment device at a less treatment agent cost.

~~[0018]~~[0017]

The exhaust gas treatment device may further include a second SO_x detecting unit that detects an SO_x concentration of the treated gas, and it is preferable that the controller do not change the weight of the alkaline agent when the SO_x concentration of the treated gas is equal to or less than a predetermined value.

~~[0019]~~[0018]

According to this configuration, by performing control based on the HCl/SO_x ratio only when the SO_x concentration of the treated gas is equal to or greater than a predetermined value, it is possible to operate the exhaust gas treatment device at a less treatment agent cost.

~~[0020]~~[0019]

In the exhaust gas treatment device, it is preferable that the controller increases the weight of the Ca-based alkaline agent and do not change the weight of the Na-based alkaline agent when the HCl concentration of the exhaust gas is equal to or greater than a predetermined value.

~~[0021]~~[0020]

According to this configuration, when the HCl concentration of the exhaust gas is high, only the weight of the Ca-based alkaline agent is increased and it is thus possible to further reduce an amount of Na-based alkaline agent used.

~~[0022]~~[0021]

The exhaust gas treatment device may further include a second HCl detecting unit that detects an HCl concentration of the treated gas, and it is preferable that the controller increase the weight of the Ca-based alkaline agent and do not change the weight of the Na-based alkaline agent when the HCl concentration of the treated gas is equal to or greater than a predetermined value.

~~[0023]~~[0022]

According to this configuration, when the HCl concentration of the treated gas is high, only the weight of the Ca-based alkaline agent is increased and it is thus possible to further reduce an amount of Na-based alkaline agent used.

~~[0024]~~[0023]

In the exhaust gas treatment device, the dust collector may be a bag filter, the exhaust gas treatment device may further include a gravimetric calculator that measures a deposition weight per unit area of a surface deposition layer deposited on the surface of the bag filter, and the controller may not change the weight of the alkaline agent when the deposition weight is equal to or greater than a predetermined value.

~~[0025]~~[0024]

According to this configuration, by performing control based on the HCl/SO_x ratio only when the surface deposition layer of the bag filter is thin, it is possible to operate the exhaust gas treatment device at a lower cost of a treatment agent.

~~[0026]~~[0025]

In the exhaust gas treatment device, the dust collector may be a bag filter, the

exhaust gas treatment device may further include a gravimetric calculator that measures a deposition weight per unit area of a surface deposition layer deposited on the surface of the bag filter, and the controller may increase the weight of the Ca-based alkaline agent when the deposition weight is equal to or less than a predetermined value and the HCl/SO_x ratio is equal to or greater than a predetermined value and may increase the weight of the Na-based alkaline agent when the deposition weight is equal to or greater than a predetermined value and the HCl/SO_x ratio is equal to or less than a predetermined value.

~~[0027]~~[0026]

According to this configuration, by increasing the weight of the Ca-based alkaline agent when the deposition weight of the surface deposition layer of the bag filter is equal to or less than a predetermined value, it is possible to stably produce an amount of calcium chloride-based reactant and to suppress a decrease in exhaust gas treatment performance of the dust collector.

~~[0028]~~[0027]

The exhaust gas treatment device may further include: a second SO_x detecting unit that detects an SO_x concentration of the treated gas; and a second HCl detecting unit that detects an HCl concentration of the treated gas, and it is preferable that the controller increase the weight of the Na-based alkaline agent when the HCl concentration of the treated gas is equal to or less than a predetermined value and the SO_x concentration of the treated gas is equal to or greater than a predetermined value.

~~[0029]~~[0028]

According to this configuration, when the SO_x concentration of the treated gas is high, it is possible to neutralize the treated gas using the Na-based alkaline agent.

~~[0030]~~[0029]

The exhaust gas treatment device may further include: an H_2O detecting unit that detects an H_2O concentration of the exhaust gas; and a humidification means for humidifying the exhaust gas, and it is preferable that the controller increase the weight of the Ca-based alkaline agent when the SO_x concentration of the treated gas is equal to or greater than a predetermined value and the H_2O concentration is equal to or greater than a predetermined value, and humidify the exhaust gas using the humidification means when the SO_x concentration of the treated gas is equal to or greater than a predetermined value and the H_2O concentration is equal to or less than a predetermined value~~, and increase the weight of the Ca-based alkaline agent when the SO_x concentration of the treated gas is equal to or greater than a predetermined value and the H_2O concentration is equal to or greater than a predetermined value~~.

~~[0031]~~[0030]

According to this configuration, when the H_2O concentration is equal to or less than a predetermined value, only the humidification is performed and it is thus possible to treat the exhaust gas at a lower cost. By changing HCl and the like in the exhaust gas to an aqueous solution through humidification and causing a solid-liquid reaction, it is possible to improve a demineralization rate.

~~[0032]~~[0031]

In the exhaust gas treatment device, the dust collector may be a bag filter, the exhaust gas treatment device may further include an H_2O detecting unit that detects an H2O concentration of the exhaust gas, the alkali supply unit may supply special-grade calcium hydroxide corresponding to a JIS special grade with a specific surface area of 12 to 15 m^2/g and a pore volume of 0.03 to 0.07 cm^3/g and high-reactive calcium hydroxide with a specific surface area of 30 m^2/g or more and a pore volume of 0.1 to 0.3 cm^3/g as the Ca-based alkaline agent, and the controller may selectively use the special-grade

calcium hydroxide and the high-reactive calcium hydroxide based on the H_2O concentration and the HCl/SO_x ratio.

~~[0033]~~[0032]

According to this configuration, by clarifying use conditions in which use of special-grade calcium hydroxide enhances efficiency, it is possible to reduce an amount of high-reactive calcium hydroxide used, which is expensive.

It is possible to prevent a differential pressure in the dust collector from increasing due to supply of an excessive amount of calcium oxide.

~~[0034]~~[0033]

The exhaust gas treatment device may further include a selective use boundary diagram of the special-grade calcium hydroxide and the high-reactive calcium hydroxide, which is prepared from a desulfurization rate when the special-grade calcium hydroxide is used and a desulfurization rate when the high-reactive calcium hydroxide is used, and it is preferable that the controller selectively use the special-grade calcium hydroxide and the high-reactive calcium hydroxide based on the selective use boundary diagram.

~~[0035]~~[0034]

In the exhaust gas treatment device, the selective use boundary diagram may be prepared from a performance diagram including the HCl/SO_x ratio and the desulfurization ratio, which is prepared for each of the plurality of H_2O concentrations.

~~[0036]~~[0035]

In the exhaust gas treatment device, it is preferable that Fourier-transform infrared spectroscopy be used in the first HCl detecting unit and the first SO_x detecting unit.

[Advantageous Effects of Invention]

~~[0037]~~[0036]

According to the present invention, by optimizing the weight of the alkaline agent supplied to the exhaust gas based on the HCl/SO_x ratio, it is possible to achieve high exhaust gas treatment performance using a minimum amount of treatment agent and to operate the exhaust gas treatment device at a less treatment agent cost.

[Brief Description of Drawings]

~~[0038]~~[0037]

Fig. 1 is a system diagram of an exhaust gas treatment device according to a first embodiment of the present invention.

Fig. 2 is a system diagram of an exhaust gas treatment device according to a second embodiment of the present invention.

Fig. 3 is a system diagram of an exhaust gas treatment device according to a third embodiment of the present invention.

Fig. 4 is a system diagram of an exhaust gas treatment device according to a fourth embodiment of the present invention.

Fig. 5 is a system diagram of an exhaust gas treatment device according to a fifth embodiment of the present invention.

Fig. 6 is a system diagram of an exhaust gas treatment device according to a sixth embodiment of the present invention.

Fig. 7 is a system diagram of an exhaust gas treatment device according to a seventh embodiment of the present invention.

Fig. 8 is a system diagram of an exhaust gas treatment device according to an eighth embodiment of the present invention.

Fig. 9 is a system diagram of an exhaust gas treatment device according to a ninth embodiment of the present invention.

Fig. 10 is a performance diagram illustrating a desulfurization rate at a moisture

concentration of 20 vol%.

Fig. 11 is a performance diagram illustrating a desulfurization rate at a moisture concentration of 18 vol%.

Fig. 12 is a performance diagram illustrating a desulfurization rate at a moisture concentration of 16 vol%.

Fig. 13 is a selective use boundary diagram of a Ca-based alkaline agent.

Fig. 14 is a selective use boundary diagram of a Ca-based alkaline agent at a gas temperature of 170°C.

Fig. 15 is a selective use boundary diagram of a Ca-based alkaline agent at a gas temperature of 150°C.

[Description of Embodiments]

~~[0039]~~[0038]

(First Embodiment)

Hereinafter, embodiments of the present invention will be described in detail below with reference the accompanying drawings.

As illustrated in Fig. 1, an exhaust gas treatment device 1 according to this embodiment includes a dust collector 3, a gas flow channel 5 through which an exhaust gas 4 discharged from combustion equipment 2 is introduced into the dust collector 3, a first HCl detecting unit 6 that detects an HCl concentration of the exhaust gas 4 to be introduced into the dust collector 3, a first SO_x detecting unit 7 that detects an SO_x concentration of the exhaust gas 4, a controller 8, an alkali supply unit 10 that supplies an alkaline agent to the gas flow channel 5, and a chimney 13 that discharges a treated gas 9 discharged from the dust collector 3 to the air.

~~[0040]~~[0039]

The first HCl detecting unit 6 and a second SO_x detecting unit 22 are measuring

instruments using Fourier-transform infrared spectroscopy (FT-IR), but may employ a mass spectrometer, gas chromatography, an optical detector such as a vacuum ultraviolet/mass spectrometer or an absorptiometer, a laser measuring instrument, or the like.

[~~0041~~][0040]

Examples of the combustion equipment 2 include a combustion furnace, an incinerator, a pyrolysis furnace, and a melting furnace

The inside of the dust collector 3 is partitioned into a plurality of chambers and each of the chambers is provided with a bag filter or a bag filtercarrying a catalyst (catalyst bag filter). Titanium-vanadium-based catalysts including titanium oxide, vanadium pentoxide, molybdenum oxide, tungsten oxide, or the like may be used as the catalyst.

[~~0042~~][0041]

The alkali supply unit 10 includes a calcium hydroxide supply unit 11 that supplies a Ca (calcium)-based alkaline agent such as calcium hydroxide and a sodium bicarbonate supply unit 12 that is disposed downstream from the calcium hydroxide supply unit 11 and that supplies an Na (sodium)-based alkaline agent such as sodium bicarbonate. That is, the alkali supply unit is configured to first supply the Ca-based alkaline agent to the exhaust gas 4 flowing in the gas flow channel 5 and to then supply the Na-based alkaline agent thereto.

[~~0043~~][0042]

The calcium hydroxide supply unit 11 is configured to supply the Ca-based alkaline agent at a weight which is determined by a control command sent out from the controller 8. Similarly, the sodium bicarbonate supply unit 12 is configured to supply the Na-based alkaline agent at a weight which is determined by a control command sent

out from the controller 8.

~~[0044]~~[0043]

The alkaline agent is a neutralizer which is used to neutralize acidic gas components such as hydrogen chloride (HCl, hydrochloric acid) and sulfur oxide (SO_x).

The Ca-based alkaline agent is generally Ca(OH)2 (calcium hydroxide). Hereinafter, the Ca-based alkaline agent will be described to be calcium hydroxide.

The Na-based alkaline agent is generally NaHCO3 (sodium hydrogen carbonate, sodium bicarbonate). Hereinafter, the Na-based alkaline agent will be described to be sodium bicarbonate.

~~[0045]~~[0044]

The controller 8 receives the HCl concentration of the exhaust gas 4 detected by the first HCl detecting unit 6 and the SO_x concentration of the exhaust gas 4 detected by the first SO_x detecting unit 7 and is configured to determine the weight of the alkaline agent supplied from the alkali supply unit 10 based on the detected concentrations and to send out a control command to the alkali supply unit 10.

~~[0046]~~[0045]

A control method of the exhaust gas treatment device 1 according to this embodiment will be described below.

The controller 8 in this embodiment calculates a ratio of the HCl concentration (ppm) detected by the first HCl detecting unit 6 and the SO_x concentration (ppm) detected by the first SO_x detecting unit 7, that is, an HCl/SO_x ratio=β, and controls an amount of alkaline agent used based on the value of β.

~~[0047]~~[0046]

Specifically, the controller 8 performs control of increasing the weight of calcium hydroxide when β is greater than a predetermined value (for example, 3 to 5).

The controller 8 performs control of supplying a predetermined weight of calcium hydroxide to the gas flow channel 5 and increasing the weight of sodium bicarbonate when β is less than the predetermined value.

~~[0048]~~[0047]

As described above, the value of β ranges, for example, from 3 to 5. This value is a value when it is assumed that the HCl concentration of the exhaust gas 4 is slightly high (800 ppm to 1200 ppm) and the SO_x concentration is high (200 ppm to 300 ppm). The controller 8 performs control of supplying sodium bicarbonate in addition to calcium hydroxide to the gas flow channel 5 so as to reduce the SO_x concentration when the value of β is small, that is, when the SO_x concentration of the exhaust gas 4 is high.

~~[0049]~~[0048]

According to this embodiment, by determining the weight of the alkaline agent including the Ca-based alkaline agent and the Na-based alkaline agent based on the HCl/SO_x ratio, that is, β, it is possible to optimize the weight of the alkaline agent supplied to the exhaust gas 4 and to operate the exhaust gas treatment device 1 at a less treatment agent cost.

Furthermore, since the weight of the Na-based alkaline agent such as sodium bicarbonate is increased only when the HCl/SO_x ratio=β is equal to or less than a predetermined value,~~,~~ it is possible to further reduce the amount of Na-based alkaline agent used.

~~[0050]~~[0049]

(Second Embodiment)

Hereinafter, an exhaust gas treatment device 1B according to a second embodiment of the present invention will be described with reference to the

accompanying drawing.

Fig. 2 is a system diagram illustrating an example of the exhaust gas treatment device 1B according to this embodiment. In this embodiment, description will be focused on differences from the first embodiment and description of similar elements will not be repeated.

~~[0051]~~[0050]

As illustrated in Fig. 2, in the exhaust gas treatment device 1B according to this embodiment, a cooling tower 15 as a humidification means for lowering the exhaust gas temperature and humidifying the exhaust gas 4 is installed upstream from the gas flow channel 5. The cooling tower 15 is supplied with cooling water from a water supply unit 17 via a cooling water pipe 16. An H_2O detecting unit 18 that detects an H_2O concentration is installed downstream from the first HCl detecting unit 6. A vapor supply unit 19 as a humidification means for humidifying the exhaust gas 4 is installed upstream from the alkali supply unit 10.

~~[0052]~~[0051]

A control method of the exhaust gas treatment device 1B according to this embodiment will be described now.

The controller 8 in this embodiment treats the exhaust gas 4 in consideration of the H_2O concentration in the exhaust 4 in addition to the HCl/SO_x ratio. That is, the controller 8 performs control of humidifying the exhaust gas 4 when the H_2O concentration of the exhaust gas 4 detected by the H_2O detecting unit 18 is equal to or less than a predetermined value (for example, 20% or less). Specifically, the controller 8 sends out a control command for supplying vapor to the gas flow channel 5 to the vapor supply unit 19 or sends out a control command for increasing the amount of water in the cooling tower 15 to the water supply unit 17 when the H_2O concentration is equal

to or less than the predetermined value.

~~[0053]~~[0052]

On the other hand, when the H_2O concentration is equal to or greater than the predetermined value, the same control as in the first embodiment is performed. That is, the amount of alkaline agent (calcium hydroxide, sodium bicarbonate) used is controlled based on the value of HCl/SO_x ratio=β so as to treat the exhaust gas 4.

~~[0054]~~[0053]

According to this embodiment, by selectively using and adjusting the Ca-based alkaline agent, moisture/vapor, the Na-based alkaline agent little affecting the moisture concentration in consideration of the H_2O concentration in addition to the HCl/SO_x ratio, it is possible to further optimally treat the exhaust gas 4.

When the H_2O concentration is equal to or less than the predetermined value, only humidification is performed and it is thus possible to treat the exhaust gas at a lower cost. By raising the moisture concentration in the exhaust gas 4 through the humidification, it is possible to enhance reactivity of HCl and the like in the exhaust gas 4 and to improve a demineralization rate.

~~[0055]~~[0054]

In this embodiment, the controller 8 may be configured to monitor the SO_x concentration of the exhaust gas 4 and not to change the weight of the alkaline agent, that is, not to perform control based on the HCl/SO_x ratio, when the SO_x concentration of the exhaust gas 4 is equal to or less than a predetermined value (for example, 100 ppm). By performing this control, it is possible to treat the exhaust gas at a lower cost.

~~[0056]~~[0055]

(Third Embodiment)

Hereinafter, an exhaust gas treatment device 1C according to a third

embodiment of the present invention will be described with reference to the accompanying drawing.

Fig. 3 is a system diagram illustrating an example of the exhaust gas treatment device 1C according to this embodiment. In this embodiment, description will be focused on differences from the first embodiment and description of similar elements will not be repeated.

~~[0057]~~[0056]

The exhaust gas treatment device 1C according to this configuration includes the H_2O detecting unit 18 and the vapor supply unit 19, which are the same as in the second embodiment, in addition to the device configuration of the first embodiment. An entrance side of the dust collector 3 is provided with a temperature detecting unit 21, which is configured to input the detected temperature to the controller 8.

~~[0058]~~[0057]

A control method of the exhaust gas treatment device 1C according to the third embodiment will be described now.

The controller 8 in this embodiment determines whether to humidify the exhaust gas 4 or whether to supply sodium bicarbonate to the exhaust gas 4 depending on the temperature of the exhaust gas 4 introduced into the dust collector 3.

That is, the controller 8 monitors the temperature detected by the temperature detecting unit 21 and performs control of increasing the weight of sodium bicarbonate supplied from the sodium bicarbonate supply unit 12, for example, when the H_2O concentration is equal to or less than a predetermined value (for example, 18 vol% or less) and the exhaust gas temperature detected by the temperature detecting unit 21 is equal to or higher than a predetermined value (for example, 180°C or higher).

On the other hand, when the H_2O concentration is equal to or greater than the

predetermined value, the same control as in the first embodiment is performed. That is, the amount of alkaline agent (calcium hydroxide, sodium bicarbonate) used is controlled based on the value of HCl/SO_x ratio=β so as to treat the exhaust gas 4.

~~[0059]~~[0058]

According to this embodiment, when the H_2O concentration is low, the exhaust gas is treated without supplying moisture to the exhaust gas 4 and it is thus possible to treat the exhaust gas 4 without lowering the temperature of the dust collector 3 to be lower than a predetermined temperature.

~~[0060]~~[0059]

When the temperature of the exhaust gas 4 introduced into the dust collector 3 does not need to be considered and the H_2O concentration is equal to or less than a predetermined value (for example, 18 vol% or less), control of humidifying the exhaust gas 4 using the vapor supply unit 19 may be performed.

By combining the cooling tower 15 of the second embodiment into the configuration of this embodiment, the exhaust gas 4 on the upstream side may be further humidified.

~~[0061]~~[0060]

(Fourth Embodiment)

Hereinafter, an exhaust gas treatment device 1D according to a fourth embodiment of the present invention will be described with reference to the accompanying drawing.

Fig. 4 is a system diagram illustrating an example of the exhaust gas treatment device 1D according to this embodiment.

The exhaust gas treatment device 1D according to this embodiment includes a second SO_x detecting unit 22 that detects the SO_x concentration of the treated gas 9

which is discharged from the dust collector 3 in addition to the device configuration of the second embodiment. A measuring instrument using Fourier-transform infrared spectroscopy can be employed as the second SO_x detecting unit 22.

~~[0062]~~[0061]

A control method of the exhaust gas treatment device 1D according to the fourth embodiment will be described now.

The controller 8 of this embodiment determines whether to perform control based on the HCl/SO_x ratio depending on the SO_x concentration of the treated gas 9 which is discharged from the dust collector 3.

That is, the controller 8 performs control of not changing the amount (weight) of alkaline agent supplied when the SO_x concentration of the treated gas 9 is equal to or less than a predetermined value (for example, 15 ppm to 20 ppm). On the other hand, when the SO_x concentration of the treated gas 9 detected by the second SO_x detecting unit 22 is equal to or greater than the predetermined value, the same control as in the first to third embodiments is performed. That is, the exhaust gas 4 is treated by controlling the amount of alkaline agent (calcium hydroxide, sodium bicarbonate) used based on the value of HCl/SO_x ratio=β or humidifying the exhaust gas 4 depending on the H_2O concentration.

~~[0063]~~[0062]

According to this embodiment, the control of increasing the weight of calcium hydroxide or sodium bicarbonate is performed only when the SO_x concentration of the treated gas 9 is equal to or greater than a predetermined value. Accordingly, it is possible to treat the exhaust gas 4 at a lower cost.

~~[0064]~~[0063]

The temperature of the dust collector 3 may be managed by adding the

configuration of the temperature detecting unit 21 installed upstream from the dust collector 3 of the third embodiment to the configuration of this embodiment.

~~[0065]~~[0064]

(Fifth Embodiment)

Hereinafter, an exhaust gas treatment device 1E according to a fifth embodiment of the present invention will be described with reference to the accompanying drawing.

As illustrated in Fig. 5, the exhaust gas treatment device 1E according to this embodiment includes a second HCl detecting unit 23 that detects the HCl concentration of the treated gas 9 which is discharged from the dust collector 3 in addition to the device configuration of the fourth embodiment. A measuring instrument using Fourier-transform infrared spectroscopy can be employed as the second HCl detecting unit 23.

~~[0066]~~[0065]

The controller 8 of this embodiment determines whether to perform control based on the HCl/SO_x ratio depending on the HCl concentration of the treated gas 9 which is discharged from the dust collector 3.

That is, the controller 8 performs control of not changing the amount (weight) of alkaline agent supplied when the HCl concentration of the treated gas 9 detected by the second HCl detecting unit 23 is equal to or less than a predetermined value (for example, 5 ppm to 10 ppm).

On the other hand, when the HCl concentration of the treated gas 9 detected by the second HCl detecting unit 23 is equal to or greater than the predetermined value, the same control as in the fourth embodiment is performed. That is, the exhaust gas 4 is treated based on the SO_x concentration of the treated gas 9, the value of HCl/SO_x ratio=β, the H_2O concentration of the exhaust gas 4, and the like.

~~[0067]~~[0066]

According to this embodiment, the control of increasing the weight of calcium hydroxide or sodium bicarbonate is performed only when the HCl concentration of the treated gas 9 is equal to or greater than a predetermined value. Accordingly, it is possible to treat the exhaust gas 4 at a lower cost.

~~[0068]~~[0067]

(Sixth Embodiment)

Hereinafter, an exhaust gas treatment device 1F according to a sixth embodiment of the present invention will be described with reference to the accompanying drawing.

As illustrated in Fig. 6, the exhaust gas treatment device 1F according to this embodiment includes a gravimetric calculator 24 that measures a deposition weight per unit area of a surface deposition layer which is deposited on the surface of a bag filter as the dust collector 3 in addition to the device configuration of the fifth embodiment. The gravimetric calculator 24 indirectly measures the deposition weight from a bag pressure loss, a filtration rate, and the like of the dust collector 3.

~~[0069]~~[0068]

The controller 8 of this embodiment determines whether to perform control based on the HCl/SO_x ratio depending on the state of the surface deposition layer of the bag filter as the dust collector 3.

That is, the controller 8 performs control of not changing the amount (weight) of alkaline agent supplied when the deposition weight is equal to or greater than a predetermined value (for example, 100 g/m^2), for example, just after backwashing or in a predetermined period from start of the backwashing.

On the other hand, when the deposition weight is equal to or less than the predetermined value, the same control as in the first to fifth embodiments is performed.

That is, the exhaust gas 4 is treated based on the SO_x concentration of the treated gas 9, the HCl concentration of the treated gas 9, the value of HCl/SO_x ratio=β, the H_2O concentration of the exhaust gas 4, and the like.

~~[0070]~~[0069]

According to this embodiment, the exhaust gas 4 is treated based on the value of HCl/SO_x ratio=β, the H_2O concentration of the exhaust gas 4, and the like only when the surface deposition layer deposited on the surface of the bag filter is thin. Accordingly, it is possible to treat the exhaust gas 4 at a lower cost.

~~[0071]~~[0070]

(Seventh Embodiment)

Hereinafter, an exhaust gas treatment device 1G according to a seventh embodiment of the present invention will be described with reference to the accompanying drawing.

As illustrated in Fig. 7, the exhaust gas treatment device 1F according to this embodiment includes the second SO_x detecting unit 22, the second HCl detecting unit 23, and the gravimetric calculator 24, which are the same as in the sixth embodiment, in addition to the device configuration of the exhaust gas treatment device 1 according to the first embodiment and also includes a disk-like rotary atomizer 25 that is disposed upstream of the gas flow channel 5. The rotary atomizer 25 is provided with a slurry supply unit 26 that supplies a calcium hydroxide slurry to the rotary atomizer 25.

~~[0072]~~[0071]

The controller 8 performs control of increasing the weight of sodium bicarbonate supplied from the sodium bicarbonate supply unit 12 when the deposition weight per unit area of the surface deposition layer is equal to or greater than a predetermined value (for example, 100 g/m^2), for example, just after backwashing or in a

predetermined period from start of the backwashing.

When the deposition weight is equal to or less than the predetermined value and the value of the HCl/SO_x ratio=β is equal to or greater than a predetermined value (for example, 3 to 5), control of increasing the weight of the calcium hydroxide slurry supplied to the rotary atomizer 25 is performed.

~~[0073]~~[0072]

After the calcium hydroxide slurry is supplied, although the HCl concentration of the treated gas 9 is equal to or less than a predetermined value (for example, 500 ppm), when the SO_x concentration of the treated gas 9 is equal to or greater than a predetermined value (for example, 100 ppm), control of increasing the weight of sodium bicarbonate is performed.

On the other hand, when the deposition weight is equal to or greater than the predetermined value or the value of β is equal to or less than the predetermined value, the control of the weight of the alkaline agent is not performed.

~~[0074]~~[0073]

According to this embodiment, even when the surface deposition layer just after the backwashing is thin, it is possible to stably produce an amount of calcium chloride-based reactant by increasing the weight of the calcium hydroxide slurry in the rotary atomizer 25 upstream from the dust collector 3, and it is possible to suppress a decrease in exhaust gas treatment performance of the dust collector 3.

Even when the SO_x concentration of the treated gas 9 is high, it is possible to neutralize the treated gas 9 using sodium bicarbonate.

~~[0075]~~[0074]

In this embodiment, the rotary atomizer 25 is installed as a destination of the

calcium hydroxide slurry, but the calcium hydroxide slurry may be introduced into the cooling tower 15 at the time of spraying the calcium hydroxide slurry. Accordingly, it is possible to simultaneously achieve a cooling effect of the exhaust gas 4.

~~[0076]~~[0075]

(Eighth Embodiment)

Hereinafter, an exhaust gas treatment device 1H according to an eighth embodiment of the present invention will be described with reference to the accompanying drawing.

As illustrated in Fig. 8, the exhaust gas treatment device 1H according to this embodiment includes the H_2O detecting unit 18 and the vapor supply unit 19, which are the same as in the second embodiment, in addition to the device configuration of the exhaust gas treatment device 1G according to the seventh embodiment. The rotary atomizer 25 is provided with a water supply unit 27 in addition to the slurry supply unit 26.

~~[0077]~~[0076]

The controller 8 does not perform the control of the amount (weight) of alkaline agent supplied when the deposition weight of the surface deposition layer on the bag filter is equal to or greater than a predetermined value (for example, 100 g/m^2), similarly to the seventh embodiment.

When the deposition weight is equal to or less than the predetermined value and the value of the HCl/SO_x ratio=β is equal to or greater than a predetermined value (for example, 3 to 5), control of increasing the weight of the calcium hydroxide slurry supplied to the rotary atomizer 25 is performed.

~~[0078]~~[0077]

After the calcium hydroxide slurry is supplied, when the HCl concentration of

the treated gas 9 is equal to or less than a predetermined value (for example, 500 ppm) and the SO_x concentration of the treated gas 9 is equal to or greater than a predetermined value (for example, 100 ppm), the control of the alkaline agent and humidification is performed based on the H_2O concentration. Specifically, when the H_2O concentration is equal to or greater than a predetermined value (for example, 18 vol%), the control of increasing the weight of calcium hydroxide is performed. When the H_2O concentration is equal to or less than the predetermined value, water is supplied to the rotary atomizer 25 or vapor is supplied to the exhaust gas 4 to humidify the exhaust gas 4.

On the other hand, when the deposition weight is equal to or greater than the predetermined value or the value of β is equal to or less than the predetermined value, the control of the weight of the alkaline agent is not performed.

~~[0079]~~[0078]

According to this embodiment, when the H_2O concentration is equal to or less than a predetermined value, only the humidification is performed and it is thus possible to treat the exhaust gas at a lower cost. By changing HCl and the like in the exhaust gas to an aqueous solution through humidification and causing a solid-liquid reaction, it is possible to improve a demineralization rate.

~~[0080]~~[0079]

(Ninth Embodiment)

Hereinafter, an exhaust gas treatment device 1J according to a ninth embodiment of the present invention will be described with reference to the accompanying drawing.

As illustrated in Fig. 9, the exhaust gas treatment device 1J according to this embodiment includes the H_2O detecting unit 18, which is the same as in the second embodiment, in addition to the device configuration of the exhaust gas treatment device 1A according to the first embodiment. The calcium hydroxide supply unit 11 includes a

special-grade calcium hydroxide supply unit 11a and a high-reactive calcium hydroxide supply unit 11b.

~~[0081]~~[0080]

The special-grade calcium hydroxide supply unit 11a is configured to supply industrial calcium hydroxide (hereinafter, referred to as special-grade calcium hydroxide) corresponding to a JIS special grade to the gas flow channel 5 in accordance with a command from the controller 8. The high-reactive calcium hydroxide supply unit 11b is configured to supply high-reactive calcium hydroxide, which is an agent dedicated to acidic gas components, to the gas flow channel 5.

The high-reactive calcium hydroxide is an acidic gas remover having a specific surface area and a pore volume which are three times those of the special-grade calcium hydroxide. However, the high-reactive calcium hydroxide is less useful than the special-grade calcium hydroxide in terms of costs.

~~[0082]~~[0081]

Specifically, the specific surface area of the special-grade calcium hydroxide ranges 12 m^2/g to 15 m^2/g, the pore volume thereof is 0.07 cm^3/g, and the average particle diameter thereof ranges 5.0μm to 7.0μm.

The specific surface area of the high-reactive calcium hydroxide is 30 m^2/g or more, the pore volume thereof is 0.2 cm^3/g, and the average particle diameter thereof ranges 8.0μm to 12.0μm.

~~[0083]~~[0082]

The controller 8 of this embodiment controls the amount of alkaline agent used based on the value of HCl/SO_x ratio=β and the H_2O concentration. Specifically, the controller 8 performs control of selectively using calcium hydroxide using a selective use boundary diagram of the Ca-based alkaline agent (hereinafter, referred to as a selective

use boundary diagram), which is prepared based on desulfurization performance, in addition to the control of the first embodiment.

~~[0084]~~[0083]

A method of preparing a boundary diagram will be described below.

First, when the special-grade calcium hydroxide and the high-reactive calcium hydroxide are used, the desulfurization rate η_{SOx} is calculated by Expression (1) using k_{SOx} (reaction rate constant), L (surface deposition layer thickness), and LV (filtration rate).

~~[0085]~~[0084]

$$\eta_{SOx} = 1 - \frac{C}{C0} = 1 - \exp\left[-k_{SOx}\frac{L}{LV}\right] \quad \cdots (1)$$

~~[0086]~~[0085]

Here, k_{SOx} represents the reaction rate constant and is determined depending on calcium hydroxide properties, a to be described below, β, the temperature, and the like. The calcium hydroxide properties include a pore volume and a specific surface area, and the value of k_{SOx} becomes greater as the values thereof become greater. L/LV represents a reaction time.

~~[0087]~~[0086]

k_{SOx} may be calculated by Expression (2).

$k_{SOx}=F(\alpha) \cdot G(\beta) \cdot H(CH2O)$ ... (2)

Here, a represents a ratio of an HCl concentration and an SO_x concentration at an entrance of the exhaust gas treatment device to the amount of calcium hydroxide supplied, has a value as an index indicating the amount of calcium hydroxide as a reactant relative to the HCl concentration and the SO_x concentration, and may be

calculated by Expression (3) using $C_{Ca(OH)2}$ (amount of calcium hydroxide supplied), C_{HCl} (entrance HCL concentration), and C_{SOx} (entrance SO_x concentration).

$$\alpha=C_{Ca(OH)2}/(0.5\cdot C_{HCl}+C_{SOx}) \quad \text{... (3)}$$

~~[0088]~~[0087]

For example, HCl and SO_x react with calcium hydroxide through the following reaction.

$$Ca(OH)_2+ 2HC1 \rightarrow CaCl_2+ 2H_2O$$

$$Ca(OH)_2+SO_2 \rightarrow CaSO_3+2H_2O$$

~~[0089]~~[0088]

Here, β represents a ratio of the HCl concentration and the SO_x concentration as described above and may be calculated by Expression (4).

$$\beta=C_{HCl}/C_{SOx} \quad \text{...(4)}$$

C_{H2O} represents the moisture concentration.

~~[0090]~~[0089]

L represents the thickness of the surface deposition layer (dust layer) deposited on the surface of the bag filter and may be calculated by Expression (5) using C_d (dust concentration), U_N (flow rate), t (reaction time·dust deposition time), and ρ (surface deposition layer bulk density). N is an integer.

~~[0091]~~[0090]

$$L=\left(\frac{C_d\cdot u_N\cdot t}{\rho}\right)^n \quad \cdots(5)$$

~~[0092]~~[0091]

That is, the desulfurization rate η_{SOx} may be calculated by substituting

Expression (2), the value of LV, and Expression (5) for Expression (1). Here, k_{SOx} may be calculated by substituting Expression (3), Expression (4), and C_{H2O} (for Expression (2).

~~[0093]~~[0092]

Then, the desulfurization rate η_{SOx} in each exhaust gas treatment condition (temperature, α, β, and moisture concentration) may be calculated using the above-mentioned expression. For example, performance diagrams for the special-grade calcium hydroxide and the high-reactive calcium hydroxide are prepared for each moisture concentration.

Fig. 10 is a performance diagram illustrating the desulfurization rate η_{SOx} with respect to the HCl/SO_x ratio β at a moisture concentration of 20 vol%. Fig. 11 is a performance diagram illustrating the desulfurization rate η_{SOx} with respect to the HCl/SO_x ratio β at a moisture concentration of 18 vol%. Fig. 12 is a performance diagram illustrating the desulfurization rate η_{SOx} with respect to the $HCl/_{SOx}$ ratio β at a moisture concentration of 16 vol%.

~~[0094]~~[0093]

In the drawings, an intersection of the performance curves of the special-grade calcium hydroxide and the high-reactive calcium hydroxide is calculated. Actually, a plurality of performance diagrams are prepared at moisture concentration intervals of about 1% and the intersection is calculated in each performance diagram. That is, when the value of β is less than the intersection, the desulfurization rate η_{SOx} may not be maintained without using the high-reactive calcium hydroxide. When the value of β is greater than that of the intersection, use of the special-grade calcium hydroxide is highly efficient and the high-reactive calcium hydroxide requiring a high cost does not need to

be used.

~~[0095]~~[0094]

The relationship between the value of β and the moisture concentration of the X axis of each intersection is plotted in a graph illustrated in Fig. 13 and this graph is used as the selective use boundary diagram. In the selective use boundary diagram, when the points at which the measured value of β and the moisture concentration are plotted are located above the selective use boundary acquired from a plurality of intersections, the desulfurization rate η_{SOx} is improved using the special-grade calcium hydroxide. That is, the Ca-based alkaline agent of a low cost and high efficiency may be used.

As can be seen from Figs. 12 and 13, the lower the moisture concentration becomes, the lower the desulfurization rate η_{SOx} of the special-grade calcium hydroxide becomes and the broader the range of β requiring the high-reactive calcium hydroxide becomes.

~~[0096]~~[0095]

A control method of the exhaust gas treatment device 1J according to this embodiment will be described now.

The controller 8 of this embodiment determines an amount of alkaline agent used based on the value of $HCl/_{SOx}$ ratio=β, similarly to the exhaust gas treatment device 1 according to the first embodiment.

~~[0097]~~[0096]

As for calcium hydroxide, an optimal type (low cost and high efficiency) of Ca-based alkaline agent is selected and used based on the selective use boundary diagram illustrated in Fig. 13. That is, the H20 concentration (moisture concentration) and the value of $HCl/_{SOx}$ ratio=β are plotted in the selective use boundary diagram and the

special-grade calcium hydroxide and the high-reactive calcium hydroxide are selectively used.

~~[0098]~~[0097]

According to this embodiment, by clarifying the use conditions in which use of the special-grade calcium hydroxide enhances efficiency, it is possible to reduce the amount of high-reactive calcium hydroxide used, which is expensive.

In other words, since the desulfurization rate η_{SOx} is strongly affected by the correlation between moisture concentration and the HCl/SO_x ratio, it is possible to obtain high exhaust gas treatment performance with a minimum amount and at a low cost by changing the type of Ca-based alkaline agent or adjusting the amount thereof depending on the moisture concentration value and the HCl/SO_x ratio or performing optical control.

It is possible to prevent a differential pressure in the dust collector 3 from increasing due to supply of an excessive amount of calcium oxide.

~~[0099]~~[0098]

The first HCl detecting unit 6, the first SO_x detecting unit 7, and the H_2O detecting unit 18 are installed upstream from the dust collector 3, but may be installed at any position between the dust collector 3 and the exit of the combustion equipment 2. When the HCl concentration, the SOx concentration, and the H_2O concentration at the exit of the combustion equipment 2 may be predicted, measurement is not necessary and the selective use boundary diagram may be prepared based on the predicted values.

~~[0100]~~[0099]

(Modified Example of Ninth Embodiment)

A modified example of the ninth embodiment will be described below. In this modified example, the selective use boundary diagram of the Ca-based alkaline agent is prepared for each temperature to be used and calcium hydroxide is selected and used

based on the selective use boundary diagram.

~~[0101]~~[0100]

For example, the selective use boundary diagram at a filtration rate of LV=0.8 m/min, a gas temperature of T=170°C, and α=3 is the same as illustrated in Fig. 14. The selective use boundary diagram (that is, the temperature is changed relative to that in Fig. 14) at a filtration rate of LV=0.8m/min, a gas temperature of T=150°C, and α=3 is the same as illustrated in Fig. 15.

In Figs. 14 and 15, the lower the temperature of the gas temperature becomes and the higher the moisture concentration becomes, the broader the use condition range of the special-grade calcium hydroxide with a low cost and high efficiency becomes.

~~[0102]~~[0101]

The technical scope of the present invention is not limited to the above-mentioned embodiments, but the embodiments can be modified in various forms without departing from the gist of the present invention. For example, in the above-mentioned embodiments, the alkaline agent is supplied downstream from the first ~~SOx~~ SO_x detecting unit 7 and the first HCl detecting unit 6, but the alkaline agent may be supplied upstream from the detecting units.

[Industrial Applicability]

~~[0103]~~[0102]

The above-mentioned exhaust gas treatment device can be widely applied to exhaust gas treatment devices that includes a dust collector into which exhaust gas is introduced and which discharges a treated gas and that supplies an alkaline agent including a Ca-based alkaline agent and a Na-based alkaline agent to a gas flow channel through which the exhaust gas is introduced into the dust collector.

[Reference Signs List]

~~[0104]~~[0103]

1, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1J Exhaust gas treatment device

2 Combustion equipment

3 Dust collector

4 Exhaust gas

5 Gas flow channel

6 First HCl detecting unit

7 First SO_x detecting unit

8 Controller

9 Treated gas

10 Alkali supply unit

11 Calcium hydroxide supply unit

11a Special-grade calcium hydroxide supply unit

11b High-reactive calcium hydroxide supply unit

12 Sodium bicarbonate supply unit

15 Cooling tower

16 Cooling water pipe

17 Water supply unit

18 H2O detecting unit

19 Vapor supply unit

21 Temperature detecting unit

22 Second SO_x detecting unit

23 Second HCl detecting unit

24 Gravimetric calculator

25 Rotary atomizer

[CLAIMS]

[Claim 1]

An exhaust gas treatment device comprising:

a dust collector into which exhaust gas is introduced and that discharges a treated gas;

a gas flow channel through which the exhaust gas is introduced into the dust collector;

a first HCl detecting unit that detects an HCl concentration of the exhaust gas;

a first SO_x detecting unit that detects an SO_x concentration of the exhaust gas;

an alkali supply unit that supplies the gas flow channel with an alkaline agent including a Ca-based alkaline agent ~~and/~~or with an alkaline agent including a Ca-based alkaline agent and an Na-based alkaline agent at a weight which is determined by a control command based on the control command; and

a controller that determines the weight of the alkaline agent and that sends out the control command,

wherein the controller ~~determines the weight based on an HCl/SO_x ratio which is~~ increases the weight of the Ca-based alkaline agent when an HCl/SO_x ratio is equal to or greater than a predetermined value and increases the weight of the Na-based alkaline agent when the HCl/SO_x ratio is equal to or less than the predetermined value, the HCl/SOx ratio calculated from the HCl concentration detected by the first HCl detecting unit and the SO_x concentration detected by the first SO_x detecting unit.

[Claim 2]

~~The exhaust gas treatment device according to claim 1, wherein the controller increases the weight of the Ca-based alkaline agent when the HCl/SO_x ratio is equal to or greater than a predetermined value and increases the weight of the Na-based alkaline~~

~~agent when the HCl/SO_x ratio is equal to or less than the predetermined value.~~

~~[Claim 3]~~

The exhaust gas treatment device according to claim 1 ~~or 2~~, further comprising:

an H_2O detecting unit that detects an H_2O concentration of the exhaust gas; and

a humidification means for humidifying the exhaust gas,

wherein the controller humidifies the exhaust gas using the humidification means and does not change the weight of the alkaline agent when the H_2O concentration is equal to or less than a predetermined value.

~~[Claim 4]~~[Claim 3]

The exhaust gas treatment device according to claim ~~3~~ 2, further comprising a temperature detecting unit that detects a temperature of the exhaust gas which is introduced into the dust collector,

wherein the controller increases the weight of the Na-based alkaline agent when the H_2O concentration is equal to or less than a predetermined value and the temperature of the exhaust gas is equal to or higher than ~~THE~~ the predetermined temperature.

~~[Claim 5]~~[Claim 4]

The exhaust gas treatment device according to any one of claims 1 to ~~4~~ 3, wherein the controller does not change the weight of the alkaline agent when the SO_x concentration of the exhaust gas is equal to or less than a predetermined value.

~~[Claim 6]~~[Claim 5]

The exhaust gas treatment device according to any one of claims 1 to ~~5~~ 4, further comprising a second SO_x detecting unit that detects an SO_x concentration of the treated gas,

wherein the controller does not change the weight of the alkaline agent when the SO_x concentration of the treated gas is equal to or less than a predetermined value.

~~[Claim 7]~~[Claim 6]

The exhaust gas treatment device according to any one of claims 1 to ~~6~~ 5, wherein

the controller increases the weight of the Ca-based alkaline agent and does not change the weight of the Na-based alkaline agent when the HCl concentration of the exhaust gas is equal to or greater than a predetermined value.

~~[Claim 8]~~[Claim 7]

The exhaust gas treatment device according to any one of claims 1 to ~~7~~ 6, further comprising a second HCl detecting unit that detects an HCl concentration of the treated gas,

wherein the controller increases the weight of the Ca-based alkaline agent and does not change the weight of the Na-based alkaline agent when the HCl concentration of the treated gas is equal to or greater than a predetermined value.

~~[Claim 9]~~[Claim 8]

The exhaust gas treatment device according to any one of claims 1 to ~~8~~ 7, wherein the dust collector is a bag filter,

wherein the exhaust gas treatment device further comprises a gravimetric calculator that measures a deposition weight per unit area of a surface deposition layer deposited on the surface of the bag filter, and

wherein the controller does not change the weight of the alkaline agent when the deposition weight is equal to or greater than a predetermined value.

~~[Claim 10]~~[Claim 9]

The exhaust gas treatment device according to claim 1, wherein the dust collector is a bag filter,

wherein the exhaust gas treatment device further comprises a gravimetric calculator that measures a deposition weight per unit area of a surface deposition layer deposited on the surface of the bag filter, and

wherein the controller increases the weight of the Ca-based alkaline agent when the

deposition weight is equal to or less than a predetermined value and the HCl/SO_x ratio is equal to or greater than the predetermined value, and

increases the weight of the Na-based alkaline agent when

the deposition weight is equal to or greater than ~~a~~ the predetermined value ~~or~~ and the HCl/SO_x ratio is equal to or less than a predetermined value~~, just after backwashing of the bag filteror in a predetermined period from start of the backwashing, and~~

~~increases the weight of the Ca-based alkaline agent when the deposition weight is equal to or less than the predetermined value and the HCl/SO_x ratio is equal to or greater than the predetermined value.~~

~~[Claim 11]~~[Claim 10]

The exhaust gas treatment device according to claim ~~10~~ 9, further comprising:

a second SO_x detecting unit that detects an SO_x concentration of the treated gas; and

a second HCl detecting unit that detects an HCl concentration of the treated gas,

wherein the controller increases the weight of the Na-based alkaline agent when the HCl concentration of the treated gas is equal to or less than a predetermined value and the SO_x concentration of the treated gas is equal to or greater than a predetermined value.

~~[Claim 12]~~[Claim 11]

The exhaust gas treatment device according to claim ~~11~~ 10, further comprising:

an H_2O detecting unit that detects an H_2O concentration of the exhaust gas; and

a humidification means for humidifying the exhaust gas,

wherein the controller increases the weight of the Ca-based alkaline agent when the SO_x concentration of the treated gas is equal to or greater than a predetermined value and the H_2O concentration is equal to or greater than a predetermined value, and

humidifies the exhaust gas using the humidification means when the SO_x concentration of the treated gas is equal to or greater than a predetermined value and the

H_2O concentration is equal to or less than a predetermined value.

~~[Claim 13]~~[Claim 12]

The exhaust gas treatment device according to claim ~~1~~ 2, wherein the dust collector is a bag filter,

wherein the exhaust gas treatment device further comprises an H_2O detecting unit that detects an H_2O concentration of the exhaust gas, and

wherein the alkali supply unit supplies special-grade calcium hydroxide corresponding to a JIS special grade with a specific surface area of 12 to 15 m^2/g and a pore volume of 0.03 to 0.07 cm^3/g and high-reactive calcium hydroxide with a specific surface area of 30 m^2/g or more and a pore volume of 0.1 to 0.3 cm^3/g as the Ca-based alkaline agent, and

wherein the controller selectively uses the special-grade calcium hydroxide and the high-reactive calcium hydroxide based on the H_2O concentration and the HCl/SO_x ratio.

~~[Claim 14]~~[Claim 13]

The exhaust gas treatment device according to claim ~~13~~ 12, further comprising a selective use boundary diagram of the special-grade calcium hydroxide and the high-reactive calcium hydroxide, which is prepared from a desulfurization rate when the special-grade calcium hydroxide is used and a desulfurization rate when the high-reactive calcium hydroxide is used,

wherein the controller selectively uses the special-grade calcium hydroxide and the high-reactive calcium hydroxide based on the selective use boundary diagram.

~~[Claim 15]~~[Claim 14]

The exhaust gas treatment device according to claim ~~14~~ 13, wherein the selective use boundary diagram is prepared from a performance diagram including the HCl/SO_x

ratio and the desulfurization ratio, which is prepared for each of the plurality of H_2O concentrations.

~~[Claim 16]~~[Claim 15]

The exhaust gas treatment device according to any one of claims 1 to ~~15~~ 14, wherein Fourier-transform infrared spectroscopy is used in the first HCl detecting unit and the first SO_x detecting unit.