DESCRIPTION

EXHAUST GAS DESULFURIZER

Technical Field

[0001]

The present invention relates to an exhaust gas desulfurizer employed in an electric power plant, such as a coal-fired, crude oil-fired, or heavy oil-fired power plant, and particularly relates to an exhaust gas desulfurizer for desulfurization using a seawater method.

Background Art

[0002]

Conventionally, in an electric power plant using coal, crude oil, or the like as fuel, sulfur oxides (SOx), such as sulfur dioxide (SO_2), are removed from combustion exhaust gas (hereinafter called "boiled exhaust gas") discharged from a boiler, and the boiler exhaust gas is discharged into the atmosphere. Known examples of such desulfurization treatment with an exhaust gas desulfurizer include systems employing a limestone-plaster method, a spray dryer method, or a seawater method.

[0003]

Among these systems, an exhaust gas desulfurizer

employing the seawater method (hereinafter called "seawater desulfurizer") is a desulfurization system using seawater as an absorbent. In this system, for example, seawater and boiler exhaust gas are supplied to the inside of a desulfurization tower (absorption tower) having a substantially cylindrical shape, such as a vertically disposed cylinder, to cause gas-liquid contact in wet bases, thereby removing sulfur oxides using the seawater as an absorbing solution.

As shown in Fig. 6, for example, in the seawater desulfurizer 1, gas-liquid contact is formed between the rising boiler exhaust gas supplied from the lower portion of the desulfurization tower 2 and the freely falling seawater supplied from the upper portion of the desulfurization tower 2. The gas-liquid contact between the boiler exhaust gas and the seawater is achieved by passing them through a large number of holes 4 provided in each of a plurality of perforated panels 3 arranged at predetermined intervals in the vertical direction of the desulfurization tower 2, functioning as wet bases. In the drawing, reference numeral 5 denotes a seawater-supplying pipe, reference numeral 6 denotes a seawater-draining pipe for draining seawater after desulfurization, reference numeral 7 denotes a boiler exhaust gas supply port, and reference numeral 8 denotes a boiler exhaust gas exhaust port for discharging boiler exhaust gas

after desulfurization (refer to, for example, Patent Documents Nos. 1 and 2).

Patent Document 1:

Japanese Unexamined Patent Application, Publication No. Hei 11-290643

Patent Document 2:

Japanese Unexamined Patent Application, Publication No. 2001-129352

Disclosure of Invention

[0004]

The desulfurization tower 2 of the aforementioned seawater desulfurizer 1 is structured to conduct desulfurization by gas-liquid contact between boiler exhaust gas rising up from the lower portion and seawater falling from the upper portion. Therefore, heterogeneous distributions of the flows of the boiler exhaust gas and the seawater in a horizontal cross-section of the desulfurization tower 2 reduce the desulfurization performance.

More specifically, as shown in Fig. 6, for example, if drift, that is, heterogeneous distributions of the flow of boiler exhaust gas and the flow of seawater, occurs in a horizontal cross-section of the desulfurization tower 2, the rising flow of the boiler exhaust gas (indicated by the solid-line arrow) and the freely falling flow of the seawater

(indicated by the broken-line arrow in the drawing) are separated from each other, resulting in a phenomenon whereby the boiler exhaust gas blows through, that is, the boiler exhaust gas and the seawater pass through holes 4 in different regions, respectively. Consequently, the contact between the boiler exhaust gas and the seawater becomes insufficient, and a flow ratio contributing to desulfurization by mutual contact between the boiler exhaust gas and the seawater is decreased.

[0005]

The aforementioned drift and blow-through phenomenon cause a decrease in desulfurization performance: that is, sulfur oxides in the boiler exhaust gas are not sufficiently desulfurized, and boiler exhaust gas containing sulfur oxides is exhausted. Such drift and blow-through phenomenon become more significant with an increase in the cross-sectional area of the desulfurization tower 2 resulting from an increase in the amount of boiler exhaust gas to be treated or by adjusting the rising rate of the boiler exhaust gas to a relatively low desired range.

The aforementioned drift is thought to be due to various causes, mainly, the inflow rate of the boiler exhaust gas (inlet nozzle size of a boiler exhaust gas supply port 7), the inflow angle of the boiler exhaust gas, the size (width, depth, and height, or tower diameter and height) of the desulfurization tower 2, and the positions and the number of

perforated panels 3. However, it is necessary to analyze the above-mentioned causes by model tests or simulation tests to find the optimum size, shape, and the like for preventing occurrence of drift, but such analysis is a very difficult process requiring large amounts of time and cost.

[0006]

Thus, in an exhaust gas desulfurizer employing the seawater method (seawater desulfurizer), since desulfurization performance is decreased by drift and a blow-through phenomenon of the boiler exhaust gas, which are readily caused by an increase in size or the like of the desulfurization tower, there is a demand for development of an exhaust gas desulfurizer that can reliably prevent the decrease in the desulfurization performance with an easy and simple structure to obtain good desulfurization performance.

The present invention has been made under these circumstances and provides an exhaust gas desulfurizer, employing a seawater method, which can reliably prevent drift and a blow-through phenomenon of boiler exhaust gas with an easy and simple structure and which can achieve good desulfurization performance.

[0007]

The present invention employs the following solutions for solving the aforementioned problems.

In an exhaust gas desulfurizer according to an aspect of

the present invention employing a seawater method in which desulfurization is conducted by gas-liquid contact of combustion exhaust gas rising up from the lower portion of a desulfurization tower and seawater falling from the upper portion of the desulfurization tower, the exhaust gas desulfurizer includes:

vertically extending partition plates that divide a horizontal cross-sectional area in the desulfurization tower into predetermined values or less.

[0008]

In such an exhaust gas desulfurizer, since the vertically extending partition plates are arranged so that a horizontal cross-sectional area in the desulfurization tower is divided into predetermined values or less, the flow of seawater in the horizontal direction is regulated by the partition plates, therefore causing hardly any drift.

[0009]

In the aforementioned aspect, it is preferable that the gas-liquid contact be conducted in wet bases of perforated panels and that the partition plates extend upward from the wet bases to positions higher than at least the height of the seawater remaining on the wet bases. By doing so, drift can be prevented while maintaining a minimum loss in pressure.

Furthermore, in the aforementioned aspect, the gas-liquid contact may be achieved by either a spray system or a filling

system.

[0010]

According to the aforementioned aspect, the flow of seawater in the horizontal direction is regulated by arranging the vertically extending partition plates so that a horizontal cross-sectional area in the desulfurization tower is divided into predetermined values or less. Consequently, hardly any drift occurs, that is, distributions of the flow of upward rising combustion exhaust gas and the flow of downward falling seawater becoming heterogeneous in a horizontal cross-section. Therefore, in an exhaust gas desulfurizer employing a seawater method, since drift and the blow-through phenomenon of boiler exhaust gas, which are readily caused by an increase in size or the like of the desulfurization tower, can be reliably inhibited or prevented with an easy and simple structure, good desulfurization performance can be obtained.

Brief Description of Drawings

[0011]

[FIG. 1] Fig. 1 is a cross-sectional view illustrating an embodiment of a seawater desulfurizer according to the present invention.

[FIG. 2] Fig. 2 is a cross-sectional view taken along the line A-A in Fig. 1.

[FIG. 3] Fig. 3 is an explanatory diagram illustrating a

height H of partition plates.

[FIG. 4] Fig. 4 is a cross-sectional view illustrating a first modification of the seawater desulfurizer according to the present invention.

[FIG. 5A] Fig. 5A is a cross-sectional view illustrating a second modification of the seawater desulfurizer according to the present invention;.

[FIG. 5B] Fig. 5B is a cross-sectional view illustrating a conventional example of a seawater desulfurizer.

[FIG. 6] Fig. 6 is a cross-sectional view showing a conventional structure of a seawater desulfurizer.

[0012]

Explanation of Reference Signs:

1A, 1B, 1C: seawater desulfurizer

2: desulfurization tower

3: perforated panel

4: pore

10: partition plate

20: spray nozzle

30: filling unit

Best Mode for Carrying Out the Invention

[0013]

An embodiment of an exhaust gas desulfurizer according to the present invention will now be described with reference to

the drawings.

A desulfurization tower 2 of a seawater desulfurizer 1A shown in Fig. 1 is a device for removing, using a seawater method, sulfur oxides (SOx), such as sulfur dioxide (SO_2), contained in combustion exhaust gas (hereinafter called "boiler exhaust gas") discharged from a boiler, for example, of an electric power plant using coal, crude oil, or the like as fuel, before discharging the boiler exhaust gas into the atmosphere. The seawater desulfurizer 1A employing this desulfurization system called the seawater method uses seawater as an absorbent.

[0014]

The seawater desulfurizer 1A shown in the drawing removes sulfur oxides by causing gas-liquid contact in wet bases, using seawater as an absorbent, by supplying seawater and boiler exhaust gas to the inside of the desulfurization tower 2 which has a substantially cylindrical shape and which vertically disposed. The seawater supplied to the desulfurization tower 2 is discharged from an upper portion in the desulfurization tower 2 and thereby freely falls in the interior. On the other hand, the boiler exhaust gas is introduced into the desulfurization tower 2 from a lower portion and rises up in the desulfurization tower 2.

The desulfurization tower 2 includes a plurality of perforated panels 3 arranged at predetermined intervals in the

vertical direction in the inside thereof. These perforated panels 3 are perforated plates not having weirs or overflow part, and gas-liquid contact between the rising boiler exhaust gas and the falling seawater is caused when they pass through a large number of holes 4 provided in the perforated panels 3.

[0015]

That is, the perforated panels 3 function as wet bases causing gas-liquid contact of the seawater introduced via a seawater-supplying pipe 5 and the boiler exhaust gas introduced from a boiler exhaust gas supply port 7. By causing this gas-liquid contact, sulfur oxides in the boiler exhaust gas are absorbed by the seawater serving as an absorbent solution and are removed. After the gas-liquid contact achieved by passing through the perforated panels 3, in other words, after desulfurization by absorbing and removing sulfur oxides in the boiler exhaust gas, the seawater falls to the bottom of the desulfurization tower 2 and is discharged from a used seawater outlet 6, and the boiler exhaust gas is discharged from a boiler exhaust gas exhaust port 8 formed at the upper portion.

[0016]

The seawater desulfurizer 1A having the aforementioned structure has vertically extending partition plates 10 arranged so that a horizontal cross-section in the desulfurization tower 2 is divided into small areas each

having an area of a predetermined value or less. These partition plates 10 are independently provided on each stage of the perforated panels 3. That is, the partition plates 10 divide the horizontal cross-sectional area of each stage of the perforated panels 3 by forming walls standing approximately perpendicularly from the perforated panel 3 of each stage.

Fig. 2 is a diagram illustrating an example of the horizontal cross-sectional area divided by the partition plates 10. In this example of division, the horizontal cross-sectional area of the desulfurization tower 2 is divided into 24 sections by a circular partition plate 11 dividing the radial direction into two, radial partition plates 12 dividing the circumferential direction into eight at a 45-degree pitch, and radial subdivision partition plates 13 further dividing each section of the circumference of the circular partition plate 11 into two in the circumferential direction.

[0017]

The aforementioned partition plates 10 are configured to have a height H at least higher than the height h of the seawater remaining on the wet bases 3 ($H > h$). That is, the height H of the walls standing from the perforated panels 3 serving as the wet bases is determined so that the seawater remaining on the wet bases 3 does not flow over the partition plates 10 to the adjacent sections. Since the height h of the

seawater remaining on the perforated panels 3 can be estimated based on the relationship between the total opening area of the holes 4 provided in the perforated panels 3 and the amount of supplied seawater, the partition plates 10 may be arranged to have a height higher than this estimated value.

[0018]

In the seawater desulfurizer 1A having the aforementioned structure, the seawater that is allowed to flow from the upper portion of the desulfurization tower 2 falls through each perforated panel 3 divided, by the partition plates 10, into horizontal cross-sectional areas each having an area of a predetermined value or less. Since the height of the surface W of seawater remaining on the perforated panels 3 is lower than the height H of the partition plates 10, the flow direction of the seawater is regulated by the partition plates 10. Therefore, the remaining seawater is prevented from flowing over the partition plates 10 to flow in the horizontal direction. Since such horizontal flow can be substantially equally prevented even if the rising boiler exhaust gas passes through the perforated panels 3 from the lower portion, drift of the boiler exhaust gas and the seawater does not occur.

Furthermore, in order to reliably prevent the horizontal flow, the height H of the partition plates 10 may be determined based on the maximum height of the seawater surface W on which waves are formed by the influence of the boiler

exhaust gas rising from the lower portion.

[0019]

As a result, the difference among the surfaces W of the seawater remaining in each section of the perforated panels 3 is decreased to be approximately constant. In other words, the distribution of the seawater remaining in each of the sections of the perforated panels 3 is maintained approximately homogeneous, and therefore the blow-through phenomenon, that is, a phenomenon where the boiler exhaust gas rising from the lower portion and the seawater are separated and pass through the perforated panels 3 without being brought into contact with each other, can be prevented.

Drift and the blow-through phenomenon of the seawater and the boiler exhaust gas are thus prevented, and therefore sufficient contact between the seawater and the boiler exhaust gas passing through the perforated panels 3 is possible. Accordingly, efficient desulfurization can be performed by effectively using the seawater supplied to the desulfurization tower 2.

[0020]

The seawater desulfurizer 1A having perforated panels 3 in the desulfurization tower 2 is described in the above-described embodiment, but a spray system or a filling system may be used instead of the gas-liquid contact using the perforated panels 3, as described below. In the drawings used

in the following description, the same portions as those in the above-described embodiment are denoted by the same reference numerals, and a detailed description thereof is not repeated.

A first modification shown in Fig. 4 is a seawater desulfurizer 1B employing gas-liquid contact achieved by means of a spray system. In this desulfurizer, a large number of spray nozzles 20 spraying seawater are arranged in the inside of the desulfurization tower 2, and desulfurization is conducted by means of gas-liquid contact of boiler exhaust gas and the seawater sprayed from the spray nozzles 20. The partition plates 10 in this case are supported at predetermined positions, for example, with spray pipes 21 or the like.

[0021]

Also in the seawater desulfurizer 1B having such a structure, the internal empty space of the desulfurization tower 2 is divided by partition plates 10 so that the horizontal cross-sectional areas each have an area of a predetermined value or less, thus preventing drift and the blow-through phenomenon of the boiler exhaust gas. This spray system can spray seawater in an approximately uniform dispersion by suitably arraying the spray nozzles 20.

[0022]

A seawater desulfurizer 1C shown in Fig. 5A as a second

modification employs gas-liquid contact achieved by means of a filling system. In this system, a filling unit 30 for accelerating the gas-liquid contact of boiler exhaust gas and seawater is disposed in the inside of the desulfurization tower 2, and partition plates 10 divide the horizontal cross-section of the filling unit 30 into a plurality of sections. Each horizontal cross-section formed by the division is reduced to a predetermined value or less.

Figure 5B shows a conventional seawater desulfurizer 1C' employing a filling system. The filling unit 30' in this case has approximately the same horizontal cross-section as that of the desulfurization tower 2, without being divided.

[0023]

Also in the seawater desulfurizer 1C having such a structure, the horizontal cross-sectional area of the filling unit 30 disposed in the inside of the desulfurization tower 2 is divided by the partition plates 10 into predetermined values or less, thus preventing drift and the blow-through phenomenon of the boiler exhaust gas.

[0024]

As described above, the flow of seawater in the horizontal direction is regulated by arranging the vertically extending partition plates 10 so that a horizontal cross-sectional area in the desulfurization tower 2 is divided into predetermined values or less. Accordingly, drift, that is,

the distributions of the flow of upward rising boiler exhaust gas and the flow of downward falling seawater becoming heterogeneous in a horizontal cross-section, tends not to occur. Therefore, in the seawater desulfurizers 1A, 1B, and 1C employing the seawater method, good desulfurization performance can be obtained by reliably inhibiting or preventing, with an easy and simple structure, drift and the blow-through phenomenon of boiler exhaust gas, which are readily caused by an increase in size or the like of the desulfurization tower 2.

The present invention is not limited to the aforementioned embodiments and can be variously modified within the scope of the present invention.

CLAIMS

1. An exhaust gas desulfurizer employing a seawater method in which desulfurization is conducted by gas-liquid contact of combustion exhaust gas rising up from the lower portion of a desulfurization tower and seawater falling from the upper portion of the desulfurization tower, the exhaust gas desulfurizer comprising:

vertically extending partition plates arranged so that a horizontal cross-sectional area in the desulfurization tower is divided into predetermined values or less.

2. The exhaust gas desulfurizer according to Claim 1, wherein the gas-liquid contact is conducted by wet bases composed of perforated panels, and the partition plates extend upward from the wet bases to positions higher than at least the height of seawater remaining on the wet bases.

3. The exhaust gas desulfurizer according to Claim 1, wherein the gas-liquid contact is achieved by a spray system.

4. The exhaust gas desulfurizer according to Claim 1, wherein the gas-liquid contact is achieved by a filling system.