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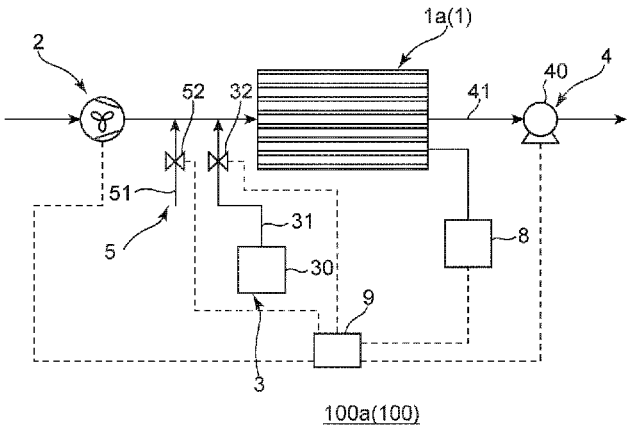
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(54) **Title:** ACID GAS COLLECTION METHOD

(54) 発明の名称： 酸性ガスの回収方法



(57) **Abstract:** Provided is an acid gas collection method that is capable of improving the amount of acid gas desorbed from an acid gas adsorbent. An acid gas collection method according to an embodiment of the present invention comprises an adsorption step and a desorption step. In the adsorption step, a gas to be processed which contains an acid gas is supplied to an acid gas adsorption device that includes an acid gas adsorbent, and the acid gas is adsorbed by the acid gas adsorbent. In the desorption step, the acid gas adsorption device is heated such that the acid gas is desorbed from the acid gas adsorbent. The desorption step includes a first desorption step and a second desorption step at least after the first desorption step. In the first desorption step, a first desorption gas is supplied to the acid gas adsorption device, and acid gas that is desorbed from the acid gas adsorbent is collected along with the first desorption gas. In the second desorption step, a second desorption gas having a lower humidity than the first desorption gas is supplied to the acid gas adsorption device, and acid gas that is desorbed from the acid gas adsorbent is collected along with the second desorption gas.

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一　国際調査報告(条約第21条(3))

(57) 要約:酸性ガス吸着材からの酸性ガスの脱離量の向上を図ることができる酸性ガスの回収方法が提供される。本発明の実施形態による酸性ガスの回収方法は、吸着工程と、脱離工程とを含んでいる。吸着工程では、酸性ガス吸着材を含む酸性ガス吸着装置に酸性ガスを含有する処理対象ガスを供給し、酸性ガス吸着材に酸性ガスを吸着させる。脱離工程では、酸性ガス吸着装置を加熱して、酸性ガス吸着材から酸性ガスを脱離させる。脱離工程は、第１脱離工程と、少なくとも第１脱離工程の後に第２脱離工程とを含んでいる。第１脱離工程において、第１脱離ガスを酸性ガス吸着装置に供給して、酸性ガス吸着材から脱離した酸性ガスを第１脱離ガスとともに回収する。第２脱離工程において、第１脱離ガスよりも湿度が低い第２脱離ガスを酸性ガス吸着装置に供給して、酸性ガス吸着材から脱離した酸性ガスを第２脱離ガスとともに回収する。

Description

Title of Invention: ACID GAS COLLECTION METHOD

Technical Field

[0001] The present invention relates to a method of capturing an acid gas.

Background Art

[0002] In recent years, an attempt has been made to separate and capture an acid gas in the atmosphere in order to reduce an environmental load. Such acid gas is, for example, carbon dioxide (hereinafter sometimes referred to as "CO_2"), which is a main cause of global warming. As a typical example of such attempt, a Carbon dioxide Capture, Utilization and Storage (CCUS) cycle has been known. As a carbon dioxide adsorption device to be used for such separation and capture of carbon dioxide, there has been proposed a gas separation unit including adsorption material layers filled with pellet-like carbon dioxide adsorption materials (see, for example, Patent Literature 1). In such a gas separation unit, the pellet-like carbon dioxide adsorption materials adsorb CO_2 from a gas fluid passing through the adsorption material layers at a predetermined adsorption temperature, and, when heated to a desorption temperature exceeding the adsorption temperature, desorb the adsorbed CO_2. In the gas separation unit described

in Patent Literature 1, however, one of CO_2 desorption reactions of amine, which is a typical CO_2 adsorption material, is: $HCO_3^- + NH_2^+R^1R^2 \rightarrow NHR^1R^2 + CO_2 + H_2O$. Thus, when there is a large amount of water in the CO_2 adsorption material and therearound, a CO_2 release reaction becomes slower or a desorption temperature rises. Thus, the desorption amount of CO_2 may be reduced.

Further, carbamate ($R^1R^2NCOO^-$), which can be generated by the reaction of amine being a CO_2 adsorption material and CO_2, is often present in a state mixed with water, which has high polarity. Thus, when there is a large amount of water in the CO_2 adsorption material and therearound at the time of the CO_2 desorption reaction, a CO_2 release reaction becomes slower or a desorption temperature rises. Thus, the desorption amount of CO_2 may be reduced.

Citation List

Patent Literature

[0003] [PTL 1] WO 2014/170184 A1

Summary of Invention

Technical Problem

[0004] A primary object of the present invention is to provide a method of capturing an acid gas, which enables achievement of an increase in desorption amount of acid gas from

an acid gas adsorption material.

Solution to Problem

[0005] [1] According to an embodiment of the present invention, there is provided a method of capturing an acid gas, including an adsorption step and a desorption step in the stated order. In the adsorption step, an acid gas is caused to be adsorbed to an acid gas adsorption material by supplying a gas to be treated including the acid gas to an acid gas adsorption device including the acid gas adsorption material. In the desorption step, the acid gas is caused to be desorbed from the acid gas adsorption material by heating the acid gas adsorption device. The desorption step includes a first desorption step and a second desorption step after at least the first desorption step. In the first desorption step, a first desorption gas is supplied to the acid gas adsorption device so that an acid gas desorbed from the acid gas adsorption material is captured together with the first desorption gas. In the second desorption step, a second desorption gas with lower humidity than humidity of the first desorption gas is supplied to the acid gas adsorption device so that an acid gas desorbed from the acid gas adsorption material is captured together with the second desorption gas.

[2] In the method of capturing an acid gas according to

the above-mentioned item [1], the acid gas may be carbon dioxide.

[3] In the method of capturing an acid gas according to the above-mentioned item [1] or [2], the second desorption step may include discharging a mixed gas including the acid gas and the second desorption gas from the acid gas adsorption device, measuring humidity of the mixed gas, and adjusting the humidity of the second desorption gas supplied to the acid gas adsorption device so that the humidity of the mixed gas falls within a desired range.

Advantageous Effects of Invention

[0006] According to the embodiments of the present invention, the method of capturing an acid gas, which enables achievement of an increase in desorption amount of acid gas from an acid gas adsorption material, can be realized.

Brief Description of Drawings

[0007] FIG. **1** is a schematic configuration view of an acid gas adsorption device related with a method of capturing an acid gas, according to one embodiment of the present invention.

FIG. **2** is a schematic perspective view of an acid gas adsorption device related with the method of capturing an acid gas, according to another embodiment of the present invention.

FIG. **3** is a schematic sectional view of the acid gas adsorption device of FIG. **2**.

FIG. **4** is a schematic configuration diagram of an acid gas capture system including the acid gas adsorption device of FIG. **2**.

Description of Embodiments

[0008] A. Overview of Method of Capturing Acid Gas

A method of capturing an acid gas according to one embodiment of the present invention includes an adsorption step and a desorption step in the stated order. In the method of capturing an acid gas, the adsorption step and the desorption step are typically repeated in the stated order. In the adsorption step, an acid gas is caused to be adsorbed to an acid gas adsorption material by supplying a gas to be treated including the acid gas to an acid gas adsorption device including the acid gas adsorption material. In the desorption step, the acid gas is caused to be desorbed from the acid gas adsorption material by heating the acid gas adsorption device. The desorption step includes a first desorption step and a second desorption step after at least the first desorption step. In the first desorption step, a first desorption gas is supplied to the acid gas adsorption device so that an acid gas desorbed from

the acid gas adsorption material is captured together with the first desorption gas. In the second desorption step, a second desorption gas with lower humidity than humidity of the first desorption gas is supplied to the acid gas adsorption device so that an acid gas desorbed from the acid gas adsorption material is captured together with the second desorption gas.

In some cases, a desorption gas is supplied to the acid gas adsorption device in the desorption step so that the acid gas desorbed from the acid gas adsorption material is captured together with the desorption gas. In such cases, a surface of the acid gas adsorption material may be excessively humidified along with the progression of the desorption step. As a result, the desorption speed of the acid gas from the acid gas adsorption material is decreased, which in turn may reduce the desorption amount of acid gas.

Meanwhile, according to one embodiment of the present invention, after the first desorption step of supplying the first desorption gas to the acid gas adsorption device is performed, the second desorption step of supplying the second desorption gas with lower humidity than that of the first desorption gas to the acid gas adsorption device is performed. Thus, even when the surface of the acid gas adsorption material is gradually humidified in the first desorption step, the humidity of the

surface of the acid gas adsorption material and in the vicinity thereof can be temporarily decreased in the second desorption step. Thus, an acid gas that has not been desorbed in the first desorption step can be smoothly desorbed. As a result, an increase in desorption amount of acid gas from the acid gas adsorption material can be achieved in the desorption step as a whole, and hence the acid gas can be efficiently captured.

Further, the supply of the second desorption gas with lower humidity than that of the first desorption gas to the acid gas adsorption device can reduce the amount of water adhering to the acid gas adsorption material and/or a base material (described later) in the acid gas adsorption device. In this manner, the desorption energy for water can be decreased, and hence energy required for heating of the acid gas adsorption device (heating energy) can be reduced.

[0009] In the adsorption step, the gas to be treated including the acid gas is typically supplied to the acid gas adsorption device having a predetermined adsorption temperature so that the acid gas is brought into contact with the acid gas adsorption material. As a result, the acid gas adsorption material adsorbs the acid gas.

Examples of the acid gas included in the gas to be treated

include carbon dioxide (CO_2), hydrogen sulfide, sulfur dioxide, nitrogen dioxide, dimethyl sulfide (DMS), and hydrogen chloride. In one embodiment, the acid gas is carbon dioxide (CO_2), and the gas to be treated is a CO_2-containing gas. The CO_2-containing gas may include nitrogen in addition to CO_2. The CO_2-containing gas is typically air (atmosphere). A concentration of CO_2 in the CO_2-containing gas is, for example, 100 ppm (on a volume basis) or more and 2 vol% or less.

The temperature of the gas to be treated that is supplied to the acid gas adsorption device is, for example, 0°C or more and 50°C or less, preferably equal to the outside air temperature.

The volumetric humidity of the gas to be treated is, for example, 0.5 g/m^3 or more, preferably 4.5 g/m^3 or more, and is, for example, 75 g/m^3 or less, preferably 30 g/m^3 or less.

[0010] A temperature (adsorption temperature) of the acid gas adsorption device in the adsorption step is, for example, 0°C or more, preferably 10°C or more, and is, for example, 50°C or less, preferably 40°C or less. In one embodiment, the adsorption temperature is equal to the outside air temperature. An operation time period of the adsorption step (adsorption time) is, for example, 15 minutes or more, preferably 30 minutes or more, and is, for example, 3 hours or less, preferably 2 hours

or less.

When the adsorption temperature and/or the adsorption time falls within the above-mentioned ranges, the adsorption gas adsorption material can efficiently adsorb the acid gas.

[0011] An acid gas capture rate in the adsorption step (=100-(concentration of the acid gas in the gas to be treated having passed through the acid gas adsorption device/concentration of the acid gas in the gas to be treated before being supplied to the acid gas adsorption device×100)) is, for example, 60% or more, preferably 75% or more, more preferably 80% or more, and is, for example, 90% or less.

[0012] In the desorption step, the acid gas adsorption device is typically heated to a desorption temperature exceeding the adsorption temperature. As a result, the acid gas, which has been adsorbed by the acid gas adsorption material in the adsorption step, is desorbed from the acid gas adsorption material. The temperature of the acid gas adsorption device in the desorption step (desorption temperature) is, for example, 70°C or more, preferably 80°C or more, and is, for example, 200°C or less, preferably 110°C or less.

[0013] The desorption step typically includes the first

desorption step and the second desorption step in the stated order. Another step may be performed between the first desorption step and the second desorption step as long as the first desorption step and the second desorption step are performed in this order.

In the first desorption step, the first desorption gas is supplied to the acid gas adsorption device that has been heated to the desorption temperature. More specifically, in the first desorption step, the temperature of the acid gas adsorption device is raised to the desorption temperature and is maintained at the desorption temperature for predetermined first desorption time, and the first desorption gas is supplied to the acid gas adsorption device. As a result, the desorbed acid gas can be captured together with the first desorption gas. The gas captured in the first desorption step is sometimes referred to as "first captured gas". The first captured gas is a mixed gas including the acid gas and the first desorption gas.

[0014] Examples of the first desorption gas include the atmosphere, carbon dioxide, water vapor, nitrogen, argon, and the first captured gas captured in the first desorption step. Those first desorption gases may be used alone or may be used in combination through mixture or sequential use. The first desorption gas is preferably the first captured gas that has

previously been captured by the acid gas adsorption device. The use of the first captured gas as the first desorption gas enables achievement of an increase in concentration of the acid gas in the first captured gas.

The volumetric humidity of the first desorption gas is, for example, 50 g/m^3 or more, preferably 40 g/m^3 or more, and is, for example, 3,500 g/m^3 or less, preferably 900 g/m^3 or less. When the humidity of the first desorption gas falls within the above-mentioned ranges, the acid gas can be smoothly desorbed from the acid gas adsorption material.

[0015] The temperature of the first desorption gas is, for example, 60°C or more, preferably 90°C or more, and is, for example, 200°C or less, preferably 160°C or less.

The flow velocity of the first desorption gas is, for example, from 0.001 m/s to 10 m/s, preferably from 0.1 m/s to 2 m/s. The flow velocity of a gas can be measured by, for example, a method described in JIS B 7556 with use of an ultrasonic flowmeter or the like.

An operation time period of the first desorption step (first desorption time for which the acid gas adsorption device is maintained at the desorption temperature) is, for example, 3

minutes or more, preferably 10 minutes or more, and is, for example, 1 hour or less, preferably 30 minutes or less. When the temperature of the first desorption gas and/or the first desorption time falls within the above-mentioned ranges, the acid gas can be more smoothly desorbed from the acid gas adsorption material.

In the first desorption step, the first captured gas can be sucked by using, for example, the first desorption gas and a depression pump in combination.

[0016] In the second desorption step that is performed subsequently to the first desorption step, the first desorption gas supplied to the acid gas adsorption device is typically switched to a second desorption gas with lower humidity than that of the first desorption gas, and the second desorption gas is supplied for predetermined second desorption time to the acid gas adsorption device that is maintained at the desorption temperature. In this manner, the desorbed acid gas is captured together with the second desorption gas. The gas captured in the second desorption step is sometimes referred to as "second captured gas". The second captured gas is a mixed gas including the acid gas and the second desorption gas. The concentration of oxygen in the second captured gas is preferably 15 vol% or less.

[0017] Examples of the second desorption gas preferably include the atmosphere, carbon dioxide, nitrogen, and argon. The second captured gas that has previously been captured by the acid gas adsorption device may also be used as the second desorption gas.

The humidity of the second desorption gas is lower than the humidity of the first desorption gas. Lower humidity of the second desorption gas is more preferred. When the humidity of the first desorption gas is defined as 100%, the humidity of the second desorption gas is, for example, 80% or less, preferably 50% or less. Further, the volumetric humidity of the second desorption gas is, for example, 2,800 g/m^3 or less, preferably 450 g/m^3 or less, more preferably 380 g/m^3 or less.

When the humidity of the second desorption gas is equal to or less than the above-mentioned upper limit, the humidity of the surface of the acid gas adsorption material after the first desorption step can be adjusted to fall within a suitable range. Thus, an acid gas, which has not been desorbed from the acid gas adsorption material in the first desorption step, can be stably desorbed. When the humidity of the first desorption gas is defined as 100%, the lower limit of the humidity of the second desorption gas is typically 10% or more, specifically 5 g/m^3 or

more.

[0018] The temperature of the second desorption gas is, for example, 60°C or more, preferably 90°C or more, and is, for example, 200°C or less, preferably 110°C or less.

The flow velocity of the second desorption gas is, for example, from 0.001 m/s to 10 m/s, preferably from 0.1 m/s to 2 m/s.

In one embodiment, an operation time period of the second desorption step (second desorption time) is shorter than the operation time period of the first desorption step (first desorption time). The second desorption time with respect to a total operation time period of the desorption step (sum of the first desorption time and the second desorption time) is, for example, 45% or less, preferably 40% or less, more preferably 30% or less, further preferably 20% or less, and is, for example, 5% or more, preferably 10% or more. The second desorption time is, for example, 50 minutes or less, preferably 20 minutes or less, and is, for example, 2 minutes or more, preferably 5 minutes or more. When the temperature of the second desorption gas and/or the second desorption time falls within the above-mentioned ranges, an acid gas, which has not been desorbed in the first desorption step, can be more stably desorbed.

In the second desorption step, the second captured gas can be sucked by using, for example, the second desorption gas and a depression pump in combination.

[0019] Embodiments of the present invention are described below with reference to the drawings. However, the present invention is not limited to these embodiments.

[0020] B. Acid Gas Adsorption Device (Carbon Dioxide Adsorption Device)

FIG. **1** is a schematic configuration view of an acid gas adsorption device related with the method of capturing an acid gas, according to one embodiment of the present invention. FIG. **2** is a schematic perspective view of an acid gas adsorption device related with the method of capturing an acid gas, according to another embodiment of the present invention. FIG. **3** is a schematic sectional view of the acid gas adsorption device of FIG. **2**.

[0021] B-1. Acid Gas Adsorption Device of First Embodiment

In one embodiment, as illustrated in FIG. **1**, an acid gas adsorption device **7** includes a plurality of adsorption material layers **71**. The plurality of adsorption material layers **71** form an acid gas adsorption part **19**. When a gas to be treated by the

acid gas adsorption device is a CO_2-containing gas, the acid gas adsorption device **7** is a carbon dioxide adsorption device **7a**.

[0022] The plurality of adsorption material layers **71** are stacked in a thickness direction thereof so as to be spaced apart from each other. In the illustrated example, five adsorption material layers **71** are arranged in parallel. However, the number of adsorption material layers **71** is not limited thereto. The number of adsorption material layers **71** is, for example, 5 or more, preferably 10 or more, more preferably 20 or more. A distance between adjacent adsorption material layers **71** among the plurality of adsorption material layers **71** is, for example, 0.5 cm or more and 1.5 cm or less.

[0023] Each of the plurality of adsorption material layers **71** includes a flexible fiber member **73** and a plurality of pellet-like adsorption materials **72**.

[0024] The flexible fiber member **73** permits passage of a gas and restricts passage of the pellet-like adsorption materials. The flexible fiber member **73** is typically formed in a hollow shape (bag shape) that allows the plurality of pellet-like adsorption materials **72** to be included therein. The flexible fiber member **73** may be a fabric or a non-woven fabric. Examples of a material for the flexible fiber member **73** include

organic fibers and natural fibers, preferably, a polyethylene terephthalate fiber, a polyethylene fiber, and a cellulosic fiber. A thickness of the flexible fiber member **73** is, for example, 25 μm or more and 500 μm or less.

[0025] The plurality of pellet-like adsorption materials **72** are filled in the flexible fiber member **73** having a hollow shape (bag shape). The pellet-like adsorption material **72** serves as an acid gas adsorption material, and typically serves as a carbon dioxide adsorption material. Examples of a material for the pellet-like adsorption material **72** include an amine-modified material, preferably amine-modified cellulose, more preferably amine-modified nanofibrillated cellulose. A mean primary particle diameter of the pellet-like adsorption material **72** is, for example, 60 μm or more and 1,200 μm or less. Any appropriate value may be used as a filling ratio of the pellet-like adsorption materials **72** in the adsorption material layer **71**.

[0026] The acid gas adsorption device **7** of the illustrated example further includes a plurality of spacers **74**. The spacer **74** is located between adjacent adsorption material layers **71** among the plurality of adsorption material layers **71**. The plurality of spacers **74** form an acid gas adsorption part **19**. This configuration allows a distance between adjacent adsorption material layers among the adsorption material layers to be stably

ensured. In one embodiment, the plurality of adsorption material layers **71** and the plurality of spacers **74** are arranged in a substantially zig-zag pattern when viewed from a direction (depth direction on the drawing sheet of FIG. **1**) orthogonal to the thickness direction of the adsorption material layers **71**.

[0027] As the acid gas adsorption device **7** as described above, there is, for example, a gas separation unit as described in WO 2014/170184 A1. The publication is incorporated herein in its entirety by reference.

[0028] B-2. Acid Gas Adsorption Device of Second Embodiment

In another embodiment, as illustrated in FIG. **2** and FIG. **3**, an acid gas adsorption device **1** includes a base material **10** and acid gas adsorption layers **15**. The base material **10** and the acid gas adsorption layers **15** form an acid gas adsorption part **19**. When a gas to be treated by the acid gas adsorption device is a CO_2-containing gas, the acid gas adsorption device **1** is a carbon dioxide adsorption device **1a**.

[0029] The structure of the base material **10** is not particularly limited, and is, for example, a honeycomb-like structure, a filter structure such as a filtration cloth, or a pellet structure. The acid gas adsorption layer **15** is not particularly limited as long as the layer is arranged on the

surface of any such base material **10**.

[0030] B-2-1. Base Material (Honeycomb-like Base Material)

In one embodiment, the base material **10** is a honeycomb-like base material **10a**. The honeycomb-like base material **10a** includes partition walls **13** that define a plurality of cells **14**.

The cells **14** each extend from a first end surface **E1** (inflow end surface) of the honeycomb-like base material **10a** to a second end surface **E2** (outflow end surface) thereof in the lengthwise direction (axial direction) of the honeycomb-like base material **10a** (see FIG. **3**). The cells **14** each have any appropriate shape in a cross section in a direction perpendicular to the lengthwise direction of the honeycomb-like base material **10a**. The sectional shapes of the cells are each, for example, a triangle, a quadrangle, a pentagon, a hexagon, a higher polygon, a circle, or an ellipse. The sectional shapes and sizes of the cells may be all the same, or may be at least partly different. Of such sectional shapes of the cells, for example, a hexagon or a quadrangle is preferred, and a square, a rectangle, or a hexagon is more preferred.

[0031] A cell density in a cross section in the direction perpendicular to the lengthwise direction of the honeycomb-like base material (specifically, the number of cells **14** per unit

area) may be appropriately set in accordance with purposes. The cell density may be, for example, from 4 cells/cm^2 to 320 cells/cm^2. When the cell density falls within such range, the strength and effective geometric surface area (GSA) of the honeycomb-like base material can be sufficiently ensured.

[0032] The honeycomb-like base material **10a** has any appropriate shape (overall shape). The shape of the honeycomb-like base material is, for example, a cylinder with a circle as its bottom, an elliptic cylinder with an ellipse as its bottom, a prismatic column with a polygon as its bottom, or a column with an indefinite shape as its bottom. The honeycomb-like base material **10a** of the illustrated example has a cylindrical shape. The outer diameter and length of the honeycomb-like base material may be appropriately set in accordance with purposes. The honeycomb-like base material may have a hollow region in a center portion thereof in the cross section in the direction perpendicular to the lengthwise direction, though the hollow region is not shown.

[0033] The honeycomb-like base material **10a** typically includes: an outer peripheral wall **11**; and a partition wall **13** positioned inside the outer peripheral wall **11**. In the illustrated example, the outer peripheral wall **11** and the partition wall **13** are integrally formed. The outer peripheral

wall **11** and the partition wall **13** may be separate bodies.

[0034] The outer peripheral wall **11** has a cylindrical shape. The thickness of the outer peripheral wall **11** may be set to any appropriate thickness. The thickness of the outer peripheral wall **11** is, for example, from 0.1 mm to 10 mm.

[0035] The partition wall **13** defines the plurality of cells **14**. More specifically, the partition wall **13** has a first partition wall **13a** and a second partition wall **13b** perpendicular to each other, and the first partition wall **13a** and the second partition wall **13b** define the plurality of cells **14**. The sectional shapes of the cells **14** are each a quadrangle except for a portion in which the first partition wall **13a** and the second partition wall **13b** are each brought into contact with the outer peripheral wall **11**. The configuration of the partition wall is not limited to the partition wall **13** described above. The partition wall may have a first partition wall extending in a radial direction and a second partition wall extending in a circumferential direction, which define a plurality of cells.

[0036] The thickness of the partition wall **13** may be appropriately set in accordance with the applications of the honeycomb-like base material. The thickness of the partition wall **13** is typically smaller than the thickness of the outer

peripheral wall **11**. The thickness of the partition wall **13** is, for example, from 0.03 mm to 0.6 mm. The thickness of the partition wall is measured, for example, through sectional observation with a scanning electron microscope (SEM). When the thickness of the partition wall falls within such range, the honeycomb-like base material can achieve sufficient mechanical strength, and can also achieve a sufficient opening area (total area of the cells in a cross section).

[0037] The porosity of the partition wall **13** may be appropriately set in accordance with purposes. The porosity of the partition wall **13** is, for example, 15% or more, preferably 20% or more, and is, for example, 70% or less, preferably 45% or less. The porosity may be measured, for example, by mercury porosimetry.

The bulk density of the partition wall **13** may be appropriately set in accordance with purposes. The density is, for example, 0.10 g/cm^3 or more, preferably 0.20 g/cm^3 or more, and is, for example, 0.60 g/cm^3 or less, preferably 0.50 g/cm^3 or less. The bulk density may be measured, for example, by mercury porosimetry.

[0038] A material for forming the partition wall **13** is typically, for example, a ceramic. Examples of the ceramic

include silicon carbide, a silicon-silicon carbide-based composite material, cordierite, mullite, alumina, silicon nitride, spinel, a silicon carbide-cordierite-based composite material, lithium aluminum silicate, and aluminum titanate. Those materials for forming the partition walls may be used alone or in combination thereof. Of those materials for forming the partition walls, for example, cordierite, alumina, mullite, silicon carbide, a silicon-silicon carbide-based composite material, and silicon nitride are preferred, and silicon carbide and a silicon-silicon carbide-based composite material are more preferred.

[0039] Such honeycomb-like base material **10a** is typically produced by the following method. First, a binder and water or an organic solvent are added to material powder including ceramic powder described above as required. The resultant mixture is kneaded to provide a body, and the body is molded (typically extruded) into a desired shape. After that, the body is dried, and is fired as required. Thus, the honeycomb-like base material **10a** is produced. When the firing is adopted, the body is fired at, for example, from 1,200°C to 1,500°C. A firing time period is, for example, 1 hour or more and 20 hours or less.

[0040] B-2-2. Acid Gas Adsorption Layer (Carbon Dioxide Adsorption Layer)

In one embodiment, the acid gas adsorption layer **15** is formed on the surface of the partition wall **13**. In the honeycomb-like base material **10a**, a gas flow passage **16** is formed in a portion (typically, a center portion) in a cross section of the cell **14** in which the acid gas adsorption layer **15** is not formed. The acid gas adsorption layer **15** may be formed on the entire inner surface of the partition wall **13** (specifically, so as to surround the gas flow passage **16**) as in the illustrated example, or may be formed on part of the surface of the partition wall. When the acid gas adsorption layer **15** is formed on the entire inner surface of the partition wall **13**, acid gas (typically, CO_2) removal efficiency can be improved.

[0041] The gas flow passage **16** extends from the first end surface **E1** (inflow end surface) to the second end surface **E2** (outflow end surface) as with the cells **14**. Examples of the sectional shape of the gas flow passage **16** include the same sectional shapes as those of the cells **14** described above. Of those, for example, a hexagon or a quadrangle is preferred, and a square, a rectangle, or a hexagon is more preferred. The sectional shapes and sizes of the gas flow passages **16** may be all the same, or may be at least partly different.

Through the cells **14** (more specifically, the gas flow passages **16**), the above-mentioned gas to be treated typically

flows in the adsorption step. Further, in one embodiment, through the cells **14** (more specifically, the gas flow passages **16**), the above-mentioned first desorption gas flows in the first desorption step, and the above-mentioned second desorption gas flows in the second desorption step.

[0042] The acid gas adsorption layer **15** includes an acid gas adsorption material in accordance with the acid gas to be adsorbed. In one embodiment, the acid gas adsorption layers **15** are carbon dioxide adsorption layers **15a**. The carbon dioxide adsorption layers **15a** include a carbon dioxide adsorption material as an example of the acid gas adsorption material.

[0043] Any appropriate compound capable of adsorbing and desorbing CO_2 may be adopted as the carbon dioxide adsorption material. Examples of the carbon dioxide adsorption material include: nitrogen-containing compounds described later; alkali compounds, such as sodium hydroxide and potassium hydroxide; carbonate salts, such as calcium carbonate and potassium carbonate; hydrogen carbonate salts, such as calcium hydrogen carbonate and potassium hydrogen carbonate; metal organic flameworks (MOF), such as MOF-74, MOF-200, and MOF-210; zeolite; activated carbon; nitrogen-doped carbon; and ionic liquids. Those carbon dioxide adsorption materials may be used alone or in combination thereof.

[0044] Of the carbon dioxide adsorption materials, a nitrogen-containing compound and an ionic liquid are preferred. More specific examples of the nitrogen-containing compound include: primary amines, such as monoethanolamine and polyvinylamine; secondary amines, such as diethanolamine, a cyclic amine, and N-(3-aminopropyl)diethanolamine; tertiary amines, such as methyldiethylamine and triethanolamine; ethylene amine compounds such as tetraethylenepentamine; amino silane coupling agents, such as aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, N-(2-aminoethyl)-3-aminopropyl-trimethoxysilane, and polyethyleneimine-trimethoxysilane; an organic monomer having a primary amino group to tertiary amino group, such as ethyleneimine and styrene having imparted thereto an amino group; an organic polymer having a primary amino group to tertiary amino group, such as a linear polyethyleneimine and a branched polyethyleneimine having a primary amino group to tertiary amino group; piperazine compounds such as 1-(2-hydroxyethyl)piperazine; amide compounds such as a polyamidoamine; a polyvinylamine; and an organic/inorganic compound having imparted thereto an amino group as a substituent.

Of the nitrogen-containing compounds, methyldiethylamine, monoethanolamine, a cyclic amine, diethanolamine, tetraethylenepentamine, ethyleneimine, a linear polyethyleneimine, a branched polyethyleneimine, and an

organic/inorganic compound having imparted thereto an amino group as a substituent are preferred.

[0045] The ionic liquid is a "salt" of a liquid formed only of an ion (an anion or a cation), and is in a liquid state under normal temperature and normal pressure (23°C, 0.1 MPaA (absolute pressure)). Examples of the cation of the ionic liquid include: an ammonium-based ion, such as an imidazolium salt or a pyridinium salt; a phosphonium-based ion; a sulfonium salt; and an inorganic ion. Examples of the anion of the ionic liquid include: a halogen-based ion, such as a bromide ion or a triflate ion; a boron-based ion such as a tetraphenylborate ion; a phosphorus-based ion such as a hexafluorophosphate ion; and a sulfur-based ion such as an alkyl sulfonate ion. Of those ionic liquids, for example, a combination of an imidazolium salt serving as a cation and a triflate ion serving as an anion is preferred.

[0046] The ionic liquid is used, more preferably, in combination with a carbon dioxide adsorption material other than the ionic liquid (hereinafter referred to as "another carbon dioxide adsorption material"). In this case, the ionic liquid coats another carbon dioxide adsorption material (for example, a nitrogen-containing compound). Thus, an improvement in performance of the carbon dioxide adsorption material and an

increase in lifetime thereof can be achieved.

The content ratio of the ionic liquid is, for example, 0.000001 part by mass or more, preferably 0.00001 part by mass or more, and is, for example, 0.1 part by mass or less, preferably 0.05 part by mass or less with respect to 1 part by mass of the other carbon dioxide adsorption material. When the content ratio of the ionic liquid falls within the above-mentioned ranges, an improvement in performance of the carbon dioxide adsorption material and an increase in lifetime thereof can be stably achieved.

[0047] In one embodiment, the carbon dioxide adsorption layer **15a** further includes a porous carrier in addition to the above-mentioned carbon dioxide adsorption material. In this case, the carbon dioxide adsorption material is typically supported by the porous carrier to face the gas flow passage. When the carbon dioxide adsorption layer includes the porous carrier, the escape of the carbon dioxide adsorption material from the carbon dioxide adsorption layer can be prevented in the adsorption step and/or the desorption step.

[0048] The porous carrier may form mesopores in the carbon dioxide adsorption layer. Examples of the porous carrier include: metal organic frameworks (MOF), such as MOF-74, MOF-

200, and MOF-210; activated carbon; nitrogen-doped carbon; mesoporous silica; mesoporous alumina; zeolite; a carbon nanotube; and a fluorinated resin such as polyvinylidene fluoride (PVDF). Of those, for example, metal organic frameworks (MOF), PVDF, activated carbon, zeolite, mesoporous silica, and mesoporous alumina are preferred. Those porous carriers may be used alone or in combination thereof. A material different from that of the carbon dioxide absorption layer is preferably adopted for the porous carrier.

[0049] The BET specific surface area of the porous carrier is, for example, 50 m^2/g or more, preferably 500 m^2/g or more. When the surface area of the porous carrier is equal to or more than the above-mentioned lower limits, the carbon dioxide adsorption material can be stably supported, and hence an increase in CO_2 capture rate can be achieved. The upper limit of the BET specific surface area of the porous carrier is typically 2,000 m^2/g or less.

[0050] When the carbon dioxide adsorption layer includes the carbon dioxide adsorption material and the porous carrier, the content ratio of the total of the carbon dioxide adsorption material and the porous carrier in the carbon dioxide adsorption layer is, for example, 30 mass% or more, preferably 50 mass% or more, and is, for example, 100 mass% or less, preferably 99 mass%

or less.

The content ratio of the carbon dioxide adsorption material in the carbon dioxide adsorption layer is, for example, 30 mass% or more, preferably 50 mass% or more, and is, for example, 99 mass% or less. The content ratio of the porous carrier is, for example, 0.01 part by mass or more, preferably 0.3 part by mass or more, and is, for example, 0.7 part by mass or less, preferably 0.5 part by mass or less with respect to 1 part by mass of the carbon dioxide adsorption material. When the content ratio of the porous carrier falls within the above-mentioned ranges, the carbon dioxide adsorption material can be more stably supported.

[0051] Further, the carbon dioxide adsorption layer may be formed only of the carbon dioxide adsorption material. In this case, the carbon dioxide adsorption material is directly supported by the partition wall **13** to face the gas flow passage. When the carbon dioxide adsorption layer is formed only of the carbon dioxide adsorption material, the content ratio of the carbon dioxide adsorption material in the carbon dioxide adsorption layer is typically 95.0 mass% or more and 100 mass% or less. When the content ratio of the carbon dioxide adsorption material falls within the above-mentioned range, an excellent CO_2 capture rate can be stably ensured.

[0052] Such a carbon dioxide adsorption layer is typically produced by the following method. A solution of the carbon dioxide adsorption material is prepared by dissolving the above-mentioned acid gas adsorption material in a solvent. Further, the above-mentioned porous carrier is added to the solvent as required. The order of addition of the carbon dioxide adsorption material and the porous carrier is not limited to any particular order. After that, the solution of the carbon dioxide adsorption material is applied onto the base material (specifically, the partition walls), and the coating film is then dried, and is sintered as required. Thus, the carbon dioxide adsorption layer is formed.

Alternatively, a dispersion liquid including the carbon dioxide adsorption material except the ionic liquid and the porous carrier is applied onto the base material, and the coating film is then dried, and is sintered as required. After that, only the ionic liquid is applied to the base material. Thus, the carbon dioxide adsorption layer is formed.

[0053] Although not shown, the acid gas adsorption device **1** may include a heating member in addition to the base material **10** and the acid gas adsorption layers **15**. The heating member can heat the base material **10**. The heating member is typically

in contact with the base material **10**. When the acid gas adsorption device includes the heating member, the temperature of the acid gas adsorption device can be smoothly raised to the desorption temperature in the desorption step.

[0054] Although not shown, the acid gas adsorption device **1** and the acid gas adsorption device **7** may each further include a case. The case has a tubular shape (hollow shape) that allows passage of a gas, and houses the acid gas adsorption part **19** therein. Examples of the tubular shape include a cylindrical shape and a rectangular tubular shape.

The acid gas adsorption part **19** is typically supported inside the case so as to be immovable relative thereto.

In the second desorption step, the second desorption gas is typically supplied to the entirety of the acid gas adsorption part **19** that is supported inside the case so as to be immovable relative thereto. When the acid gas adsorption part is supported inside the case so as to be movable relative thereto, the supply of the second desorption gas becomes nonuniform due to the presence of a boundary portion for separating the first desorption step and the second desorption step from each other. Thus, the acid gas adsorption part **19** in the vicinity of the boundary portion cannot be placed under a low-humidity

environment, and hence an acid gas desorption amount from the acid gas adsorption part **19** may decrease. Meanwhile, when the acid gas adsorption part is supported inside the case so as to be immovable relative thereto, the entirety of the acid gas adsorption part can be uniformly placed under a low-humidity environment owing to the absence of the boundary portion. Thus, an increase in acid gas desorption amount from the acid gas adsorption material **19** can be achieved.

[0055] C. Acid Gas Capture System

Next, with reference to FIG. **4**, description is given of an acid gas capture system that enables the above-mentioned method of capturing an acid gas to be performed.

An acid gas capture system **100** of the illustrated example includes an acid gas supply fan **2**, a first desorption gas supply unit **5**, a second desorption gas supply unit **3**, a capture unit **4**, a hygrometer **8**, and a control part **9** in addition to the acid gas adsorption device. The acid gas capture system **100** of the illustrated example includes one of each of the acid gas adsorption device **1**, the acid gas supply fan **2**, the first desorption gas supply unit **5**, the second desorption gas supply unit **3**, the capture unit **4**, the hygrometer **8**, and the control part **9**. However, the number of each of those components is not limited to any particular number as long as the number is one or

more.

In one embodiment, the acid gas capture system **100** is a carbon dioxide capture system **100a** including the carbon dioxide adsorption device **1a** as an example of the acid gas adsorption device **1**. The acid gas capture system **100** may include the acid gas adsorption device **7** (carbon dioxide adsorption device **7a**) in place of the acid gas adsorption device **1** (carbon dioxide adsorption device **1a**).

[0056] C-1. Acid Gas Supply Fan

The acid gas supply fan **2** is configured to supply the above-mentioned gas to be treated (typically, a CO_2-containing gas) to the acid gas adsorption device **1** (typically, the acid gas adsorption part **19**) in the adsorption step. The acid gas supply fan **2** of the illustrated example can send the gas to be treated including the acid gas toward the acid gas adsorption device **1**. Any appropriate configuration can be adopted for the acid gas supply fan **2**. The acid gas supply fan **2** and the acid gas adsorption device **1** may be connected to each other through intermediation of a pipe or a part of a container that houses the acid gas adsorption device **1**, which is located on an upstream side of the acid gas adsorption device **1**.

[0057] C-2. First Desorption Gas Supply Unit

The first desorption gas supply unit **5** is configured to supply the above-mentioned first desorption gas to the acid gas adsorption device **1** (typically, the acid gas adsorption part **19**) in the first desorption step. The first desorption gas supply unit **5** of the illustrated example includes a first desorption gas supply line **51** and a first on-off valve **52**. The first desorption gas supply line **51** is typically a pipe that allows the supply of the above-mentioned first desorption gas to the acid gas adsorption device **1**. A downstream end portion of the first desorption gas supply line **51** in a direction of supply of the desorption gas is connected to a part between the acid gas supply fan **2** and the acid gas adsorption device **1**. When the first desorption gas is the above-mentioned first captured gas, an upstream end portion of the first desorption gas supply line **51** in the direction of supply of the desorption gas is connected to an intermediate tank that stores the first captured gas, although not shown. The first on-off valve **52** is provided to the first desorption gas supply line **51**,and can open and close the first desorption gas supply line **51**. Examples of the first on-off valve **52** include a ball valve, a gate valve, and a butterfly valve. Preferably, the first on-off valve **52** is a butterfly valve.

[0058] C-3. Second Desorption Gas Supply Unit

The second desorption gas supply unit **3** is configured to

supply the above-mentioned second desorption gas to the acid gas adsorption device **1** (typically, the acid gas adsorption part **19**) in the second desorption step. The second desorption gas supply unit **3** of the illustrated example includes a dehumidifier **30**, a second desorption gas supply line **31**, and a second on-off valve **32**. The dehumidifier **30** can adjust the humidity of the above-mentioned second desorption gas. The second desorption gas supply line **31** is typically a pipe that allows the supply of the above-mentioned second desorption gas from the dehumidifier **30** to the acid gas adsorption device **1**. The second on-off valve **32** is provided to the second desorption gas supply line **31**, and can open and close the second desorption gas supply line **31**. The second on-off valve **32** is, for example, similar to the first on-off valve **52** described above.

[0059] C-4. Capture Unit

The capture unit **4** is configured to capture the acid gas that has been desorbed in the desorption step. More specifically, the capture unit **4** can capture the first captured gas including the acid gas in the first desorption step, and can capture the second captured gas including the acid gas in the second desorption step. The capture unit **4** of the illustrated example includes a suction pump **40** and a gas discharge portion **41**. The suction pump **40** can suck the gas inside the acid gas adsorption device. The suction pump **40** is, for example, a vacuum pump.

The gas, which is discharged from the acid gas adsorption device **1** and flows toward the suction pump **40**, passes through the gas discharge portion **41**. The gas discharge portion **41** may be a pipe or may be a part of the container that houses the acid gas adsorption device **1**, which is located on a downstream side of the acid gas adsorption device.

[0060] C-5. Hygrometer and Control Part

The hygrometer **8** can measure the humidity of the mixed gas (the first captured gas or the second captured gas) discharged from the acid gas adsorption device **1**, typically, the humidity of the second captured gas discharged from the acid gas adsorption device in the second desorption step. Any appropriate configuration can be adopted for the hygrometer **8**.

Although not shown, as a modification example, the hygrometer **8** may be further capable of measuring the humidity of the gas supplied to the acid gas adsorption device **1**. The humidity inside the acid gas adsorption device **1** can be more precisely controlled by measuring the humidity of the gas (typically, the second desorption gas) introduced into the acid gas adsorption device **1**.

The control part **9** can control the operation of the acid gas capture system **100**. Any appropriate configuration can be

adopted for the control part **9**. The control part **9** includes, for example, a central processing unit (CPU), a ROM, and a RAM.

[0061] D. Operation of Acid Gas Capture System

Next, description is given of an embodiment of the method of capturing an acid gas, which is performed in the acid gas capture system **100**. In one embodiment, the method of capturing an acid gas includes the above-mentioned adsorption step, a replacement step, and the above-mentioned desorption step (the first desorption step and the second desorption step) in the stated order.

[0062] In the acid gas capture system **100**, the adsorption step is first performed. In the adsorption step, the control part **9** brings the first on-off valve **52** and the second on-off valve **32** each into a closed state, and drives the acid gas supply fan **2**. As a result, the above-mentioned gas to be treated is sent by the acid gas supply fan **2**, and is supplied to the acid gas adsorption part **19** of the acid gas adsorption device **1** to flow through the gas flow passages **16**. The temperature of the acid gas adsorption device (typically, the temperature of the acid gas adsorption part **19**) in the adsorption step has been adjusted in advance to the above-mentioned adsorption temperature.

[0063] In the adsorption step, the ranges of the temperature of the gas to be treated that is to be supplied to the acid gas adsorption device are the same as the above-mentioned ranges of the adsorption temperature. The temperature of the gas to be treated may be the same as or different from the adsorption temperature of the acid gas adsorption device. The pressure of the gas to be treated is, for example, 0.3×10^5 PaA (absolute pressure) or more and 2.0×10^5 PaA or less. The relative humidity RH of the gas to be treated is, for example, 10%RH or more and 60%RH or less. The flow velocity of the gas to be treated is, for example, 0.5 m/sec or more and 5 m/sec or less.

[0064] Then, after the elapse of the above-mentioned adsorption time, the control part **9** stops the driving of the acid gas supply fan **2** to thereby complete the adsorption step.

[0065] Next, in the acid gas capture system **100**, the replacement step is performed. In the replacement step, the control part **9** brings the first on-off valve **52** from the closed state into an open state, and drives the suction pump **40**. Then, the above-mentioned first desorption gas passes through the desorption gas supply line **51** to be supplied to the acid gas adsorption part **19** of the acid gas adsorption device **1**, and flows through the gas flow passages **16**. As a result, the gas to be treated is replaced by the first desorption gas in the gas flow

passages **16**.

[0066] In the replacement step, the ranges of the temperature of the first desorption gas to be supplied to the acid gas adsorption device are the same as the above-mentioned ranges of the adsorption temperature. The pressure of the first desorption gas is, for example, from 0.1×10^4 PaA or more and 1.0×10^4 PaA or less, or, for example, from 0.1×10^4 PaA or more and 5.0×10^4 PaA or less. The operation time period of the replacement step (hereinafter referred to as "replacement time") is, for example, 1 minute or more and 30 minutes or less.

[0067] In the replacement step, a purge gas different from the first desorption gas may be introduced into the acid gas adsorption device so that the gas to be treated is replaced by the purge gas in the acid gas adsorption device. In this case, the pressure of the purge gas is, for example, from 0.1×10^4 PaA or more and 11×10^4 PaA or less. The replacement time is, for example, 1 minute or more and 30 minutes or less. Examples of the purge gas include water vapor, carbon dioxide, nitrogen, and argon.

[0068] After that, the first desorption step is performed subsequently to the replacement step in the acid gas capture system **100**. The control part **9** controls the heating member (not

shown) to heat the acid gas adsorption device **1** (typically, the acid gas adsorption part **19**) under a state in which the driving of the suction pump **40** is maintained. The heating of the acid gas adsorption device may be started halfway through the replacement step.

When the temperature of the acid gas adsorption device (typically, the temperature of the acid gas adsorption part **19**) reaches the desorption temperature, the acid gas retained in the acid gas adsorption material starts being desorbed (released) from the acid gas adsorption material. The desorbed acid gas is discharged together with the first desorption gas from the acid gas adsorption device **1**, passes through the gas discharge portion **41** and the suction pump **40**, and is then stored in the intermediate tank as required. Such a first captured gas is available for various purposes of uses as described above, and may be supplied again to the acid gas adsorption device as the first desorption gas as described above or may be used as a raw material of various kinds of industrial products (for example, a raw material of a hydrocarbon fuel).

[0069] Next, after the elapse of the above-mentioned first desorption time, the second desorption step is performed in the acid gas capture system **100**. The control part **9** brings the first on-off valve **52** from the open state into the closed state, and

brings the second on-off valve **32** from the closed state into the open state, under a state in which the driving of the suction pump **40** is maintained.

[0070] Then, the above-mentioned second desorption gas passes through the second desorption gas supply line **31**, and is supplied to the acid gas adsorption device **1** (typically, the acid gas adsorption part **19**) to flow through the gas flow passages **16**. At this time, the surface of the acid gas adsorption material, which has been humidified in the first desorption step, is adequately dried so that the humidity of the surface of the acid gas adsorption material is appropriately adjusted. As a result, an acid gas that has not been desorbed in the first desorption step is desorbed from the acid gas adsorption material. The desorbed acid gas is discharged from the acid gas adsorption device **1** together with the second desorption gas. After passing through the gas discharge portion **41** and the suction pump **40**, the desorbed acid gas is stored in a tank as required. The second captured gas may be stored in the same intermediate tank as that for the storage of the first captured gas, or may be stored in a different tank. Like the first captured gas, such a second captured gas is available for various purposes. Further, the second captured gas may be returned to the dehumidifier **30**.

Further, in the second desorption step, the control part **9** may measure (typically, monitor) the humidity of the second captured gas discharged from the acid gas adsorption device **1** with use of the hygrometer **8** and adjust the humidity of the second desorption gas supplied to the acid gas adsorption device **1** so that the humidity of the second captured gas falls within a desired range. For example, when the humidity of the mixed gas exceeds the desired range, the dehumidifier **30** is controlled to decrease the humidity of the second desorption gas supplied to the acid gas adsorption device **1**. In this manner, the humidity of the surface of the acid gas adsorption material and in the vicinity thereof can be appropriately decreased.

The volumetric humidity of the second captured gas discharged from the acid gas adsorption device in the second desorption step is, for example, 2,800 g/m^3 or less, preferably 450 g/m^3 or less, and is, for example, 380 g/m^3 or more.

[0071] After that, in the acid gas capture system **100**, the adsorption step is performed again as required. More specifically, after the control part **9** stops driving the suction pump **40**, the above-mentioned adsorption step is performed again. As described above, the adsorption step, the replacement step, the first desorption step, and the second desorption step can be repeated in the stated order in the acid gas capture system **100**.

Industrial Applicability

[0072] The method of capturing an acid gas according to the embodiment of the present invention can be used for separation and capture of an acid gas, and particularly, can be suitably used for a Carbon dioxide Capture, Utilization and Storage (CCUS) cycle.

Reference Signs List

[0073] **1** acid gas adsorption device

1a carbon dioxide adsorption device

7 acid gas adsorption device

7a carbon dioxide adsorption device

100 acid gas capture system

100a carbon dioxide capture system

Claims

[Claim 1] A method of capturing an acid gas, including, in order:

an adsorption step of causing an acid gas to be adsorbed to an acid gas adsorption material by supplying a gas to be treated including the acid gas to an acid gas adsorption device including the acid gas adsorption material; and

a desorption step of causing the acid gas to be desorbed from the acid gas adsorption material by heating the acid gas adsorption device,

wherein the desorption step includes:

a first desorption step of capturing an acid gas desorbed from the acid gas adsorption material together with a first desorption gas by supplying the first desorption gas to the acid gas adsorption device; and

after at least the first desorption step, a second desorption step of capturing an acid gas desorbed from the acid gas adsorption material together with a second desorption gas by supplying the second desorption gas with lower humidity than humidity of the first desorption gas to the acid gas adsorption device.

[Claim 2] The method of capturing an acid gas according to claim 1, wherein the acid gas is carbon dioxide.

[Claim 3] The method of capturing an acid gas according to claim

1 or 2, wherein the second desorption step includes discharging a mixed gas including the acid gas and the second desorption gas from the acid gas adsorption device, measuring humidity of the mixed gas, and adjusting the humidity of the second desorption gas supplied to the acid gas adsorption device so that the humidity of the mixed gas falls within a desired range.

Drawings

FIG. 1

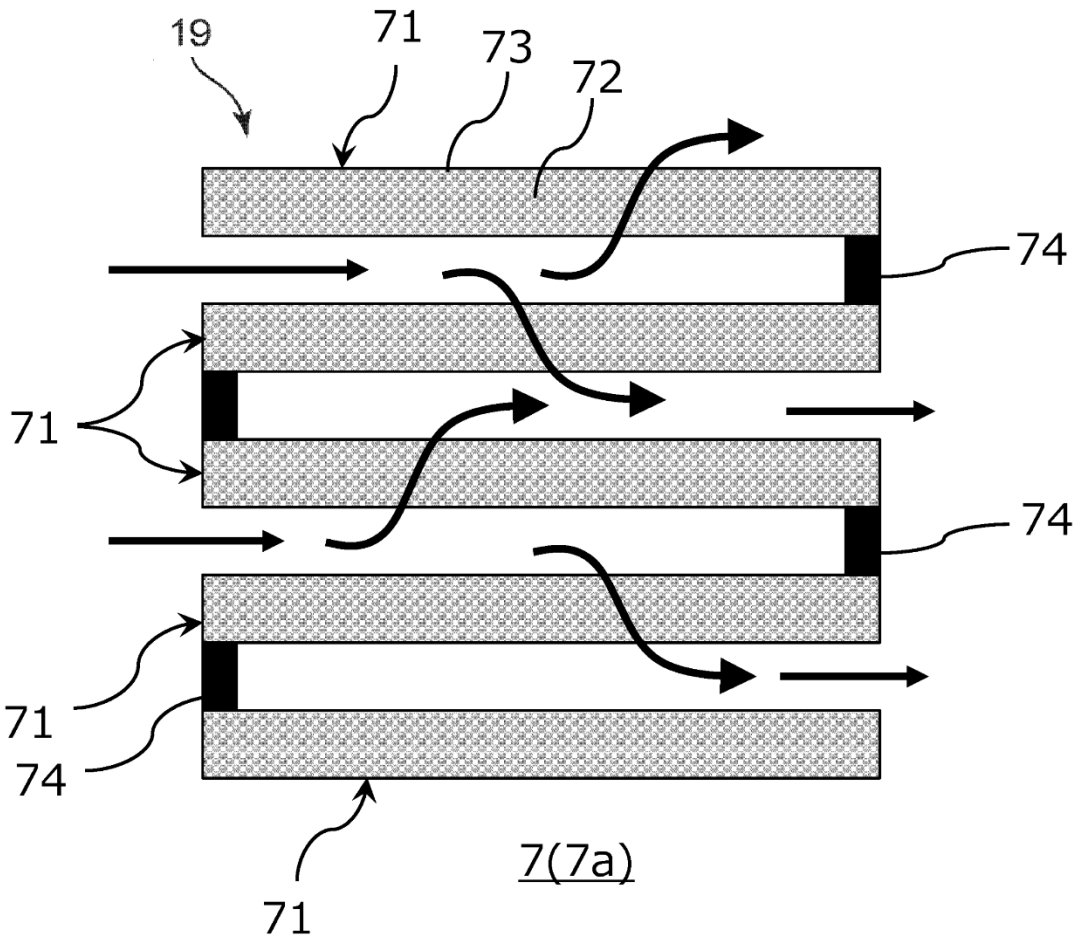


FIG. 2

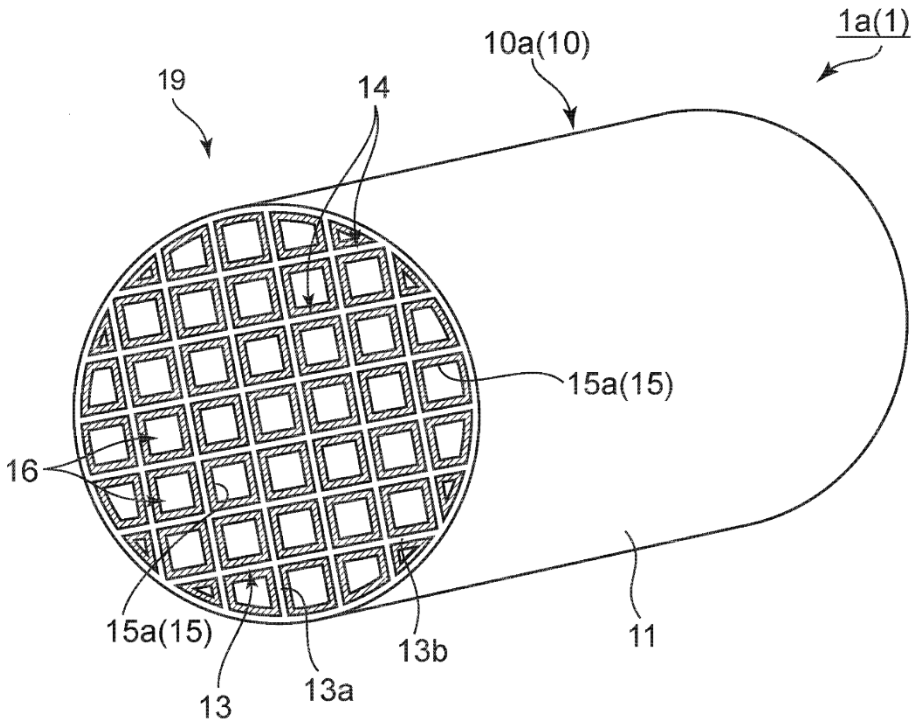


FIG. 3

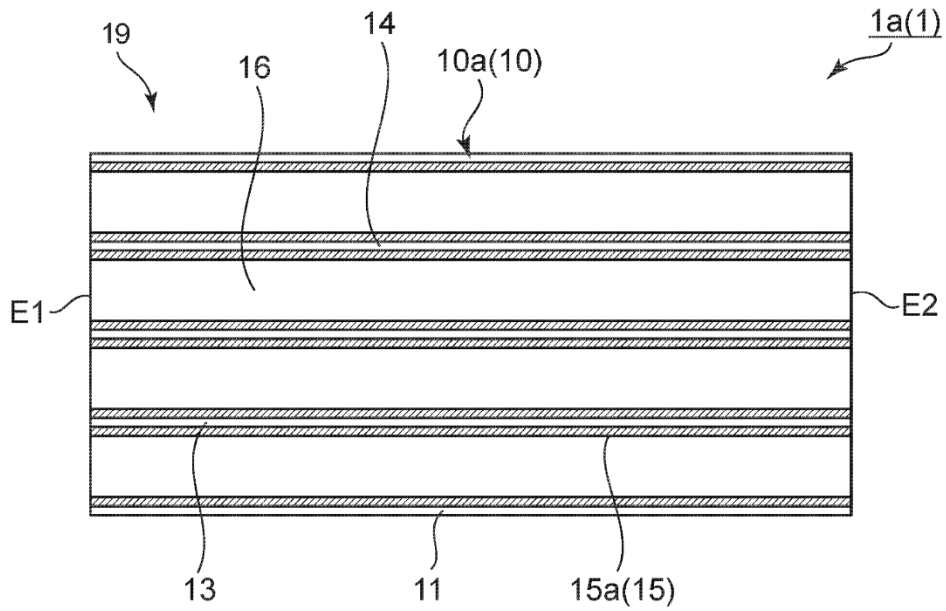


FIG. 4

