hydrogel membrane containing the vinyl alcohol-acrylic acid salt copolymer and the carbon dioxide carrier is formed in the hydrophilic porous membrane, and the hydrophobic porous membrane is superposed on the hydrogel membrane.

SUMMARY ~~OF INVENTION~~

[0004] Since the hydrogel membrane described in JP-B No. H7-102310 is used in a method of separating carbon dioxide from a high flow gas containing a large amount of steam under pressure, due to condensed water derived from the steam, the hydrogel membrane is deteriorated, and carbon dioxide separation performance is reduced.

In the carbon dioxide facilitated transport membrane laminated body described in WO2009/093666, in which a hydrogel membrane is held between two porous membranes, it is described that condensed water is repelled by the hydrophobic porous membrane, and the condensed water is prevented from being infiltrated into the hydrogel membrane. If such infiltration of the condensed water into the hydrogel membrane is prevented, the deterioration of the hydrogel membrane is reduced, and the reduction in the carbon dioxide separation performance is suppressed.

However, in the carbon dioxide facilitated transport membrane laminated body described in WO2009/093666, since the hydrogel membrane is formed in the hydrophilic porous membrane, the gas permeability at the portion is decreased, and the carbon dioxide separation performance is not satisfactory. Since a supplied gas passage member is not used, there is no problem due to the use of the supplied gas passage member.

[0005] In view of the above situations, the present ~~invention~~ disclosure provides a composite for carbon dioxide separation which certainly has excellent carbon dioxide separation performance, suppresses reduction in carbon dioxide separation performance due to the condensed water derived from steam generated in a method for separating carbon dioxide from a high flow gas containing the steam under a pressurized environment (for example, a pressure of not less than several hundred kPa, and further, for example, 1 MPa or higher), and has the carbon dioxide separation performance improved by a turbulent effect according to a porous protective layer and a supplied gas passage material. The present ~~invention~~ disclosure further provides a module for carbon dioxide separation using the composite for carbon dioxide separation and a method for producing a composite for carbon dioxide separation.

[0006] The present ~~invention~~ disclosure solving the above problem is as follows:

<1> In one aspect, there is provided a composite for carbon dioxide separation,

~~containing~~comprising, in the following order~~,~~ : a gas permeable support; a carbon dioxide separation layer containing a water absorptive polymer

and a carbon dioxide carrier; a steam permeable porous protective layer having an average thickness of from 1 μm to 500 μm; and a supplied gas passage member, which is a net-like member having a mesh opening of from 30 μm to 2000 μm;

<2> the composite for carbon dioxide separation described in <1> in which an average pore diameter of the porous protective layer is from 0.005 μm to 1000 μm;

<3> the composite for carbon dioxide separation described in <1> or <2> in which a porosity of the porous protective layer is from 3% to 90%;

[0007] <4> the composite for carbon dioxide separation described in any one of <1> to <3> in which the porous protective layer is configured from at least one of polytetrafluoroethylene, polyvinylidene-fluoride, polymethylpentene, polyphenylene sulfide, polyether sulfone, polypropylene, polysulfone, polyacrylonitrile, polyimide, or polyamide;

<5> the composite for carbon dioxide separation described in any one of <1> to <4> in which the porous protective layer and the supplied gas passage member are secured to each other;

<6> the composite for carbon dioxide separation described in any one of <1> to <5> in which the supplied gas passage member has an average thickness of from 100 μm to 1000 μm;

[0008] <7> a module for carbon dioxide separation, comprising: ~~including~~ the carbon dioxide separation composite described in any one of <1> to <6> ~~helically~~ spirally wound around a porous hollow central pipe; <8> a method for producing a composite for carbon dioxide separation, the method including: a carbon dioxide separation layer formation process for coating an aqueous solution containing a water absorptive polymer and a carbon dioxide carrier onto a gas permeable support, drying the coating, and forming a carbon dioxide separation layer; and a porous protective layer formation process for laminating a steam permeable porous protective layer having an average thickness of from 1 μm to 500 μm onto the carbon dioxide separation layer; and

<9> a method for producing a composite for carbon dioxide separation, the method ~~including~~comprising: a carbon dioxide separation layer formation process for coating an aqueous solution containing a water absorptive polymer and a carbon dioxide carrier onto a gas permeable support, drying the coating, and forming a carbon dioxide separation layer; a porous protective layer formation process for laminating a steam permeable porous protective layer having an average thickness of from 1 μm to 500 μm onto the carbon dioxide separation

layer; and a supplied gas passage member formation process for bonding the supplied gas passage member, which is a net-like member having a mesh opening of from 30 μm to 2000 μm, onto the porous protective layer.

[0009] The present ~~invention~~ disclosure provides a composite for carbon dioxide separation which

certainly has excellent carbon dioxide separation performance, suppresses reduction in carbon dioxide separation performance due to condensed water derived from steam generated in a method for separating carbon dioxide from a high flow gas containing the steam under a pressurized environment, and has the carbon dioxide separation performance improved by a turbulent effect according to a porous protective layer and a supplied gas passage material.

The present ~~invention~~ disclosure further provides a module for carbon dioxide separation using the composite for carbon dioxide separation and a method for producing a composite for carbon dioxide separation.

BRIEF DESCRIPTION OF DRAWINGS

[0010] Fig. 1 is a cross-sectional view of a composite for carbon dioxide separation according to oneembodiment of the present invention.

Fig. 2 is a configuration diagram showing a production apparatus according to one embodiment for implementing a method for producing a composite for carbon dioxide separation according to one embodiment of the invention.

Fig. 3 is a configuration diagram showing a production apparatus according to one embodiment for implementing a method for producing a composite for carbon dioxide separation according to another embodiment of the invention.

Fig. 4 is a schematic configuration diagram showing one embodiment of a spiral type module for carbon dioxide separation incorporated with the composite for carbon dioxide separation according to the present invention and partially cutout.

DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, a composite for carbon dioxide separation and a method for producing a composite for carbon dioxide separation according to the present invention will be described with reference to the drawings. In the drawings, the same reference numeral shows the same component in each drawing, and a redundant description thereof may be omitted.

[0012] <Composite for Carbon Dioxide Separation>

Fig. 1 is a cross-sectional view of a composite for carbon dioxide separation according to one embodiment of the present invention.

As shown in Fig. 1, a composite 10 for carbon dioxide separation according to the present invention is configured so that while one surface of a carbon dioxide separation layer 14 is protected by a gas permeable support 12, the other surface is protected by a steam permeable porous protective layer 16 having an average thickness of from 1 μm to 500 μm,

method similar to the porous protective layer formation process.

[0054] When the composite 10 for carbon dioxide separation according to the present invention is used by being incorporated into an after-mentioned spiral type module for carbon dioxide separation as a preferred embodiment, it is configured so that the porous protective layer 16, the carbon dioxide separation layer 14, and the gas permeable support 12 are provided on both surfaces of the member 18 for a supplied gas passage to be arranged symmetrically by interposing the member 18 for a supplied gas passage in between. Although the composite for carbon dioxide separation having such a configuration can be obtained by folding the composite for carbon dioxide separation shown in Fig. 1 into two while the member 18 for a supplied gas passage faces inside, an intermediate body provided with the carbon dioxide separation layer 14 and the porous protective layer 16 is produced on the gas permeable support 12, and a composite (hereinafter referred to as a "twofold composite for carbon dioxide separation") in which the intermediate body is folded into two so that the porous protective layer 16 is located inside while the member 18 for a supplied gas passage is interposed in between may be produced.

[0055] <Module for Carbon Dioxide Separation>

The composite 10 for carbon dioxide separation according to the present invention is incorporated into a module for carbon dioxide separation when used. The kind of the module for carbon dioxide separation into which the composite 10 for carbon dioxide separation is incorporated is not limited particularly, and the module is suitably used in a common apparatus. In the following embodiment, although the spiral type module for carbon dioxide separation in which the composite 10 for carbon dioxide separation is housed while being ~~helically~~ spirally wound around a porous hollow central pipe will be described as an example, the present invention is not limited thereto.

Fig. 4 is a schematic configuration diagram showing one embodiment of the spiral type module for carbon dioxide separation incorporated with the composite 10 for carbon dioxide separation according to the invention and partially cutout.

A spiral type module 90 for carbon dioxide separation is basically configured, around a permeable gas collecting pipe 82 constituted of a porous hollow pipe, so that a superposition 92 of a twofold composite 100 for carbon dioxide separation and a member 30 for a permeable gas passage is wound around the permeable gas collecting pipe 82, a plurality of times from a winding start side which is an end of the folded side of the twofold composite 100 for carbon dioxide separation, and the spiral type module 90 for carbon dioxide separation is configured so that the outermost periphery is covered with a covering layer 94,

CLAIMS

1. A composite for carbon dioxide separation, comprising, in the following order:

a gas permeable support;

a carbon dioxide separation layer containing a water absorptive polymer and a carbon dioxide carrier;

a steam permeable porous protective layer having an average thickness of from 1 μm to 500 μm; and

a supplied gas passage member, which is a net-like member having a mesh opening of from 30μm to 2000 μm.

2. The composite for carbon dioxide separation according to claim 1, wherein an average pore diameter of the porous protective layer is from 0.005 μm to 1000 μm.

3. The composite for carbon dioxide separation according to claim 1 or 2, wherein a porosity of the porous protective layer is from 3% to 90%.

4. The composite for carbon dioxide separation according to any one of claims 1 to 3, wherein the porous protective layer is configured from at least one of polytetrafluoroethylene, polyvinylidene-fluoride, polymethylpentene, polyphenylene sulfide, polyether sulfone, polypropylene, polysulfone, polyacrylonitrile, polyimide, or polyamide.

5. The composite for carbon dioxide separation according to any one of claims 1 to 4, wherein the porous protective layer and the supplied gas passage member are secured to each other.

6. The composite for carbon dioxide separation according to any one of claims 1 to 5, wherein the supplied gas passage member has an average thickness of from 100 μm to 1000 μm.

7. A module for carbon dioxide separation, comprising:

the carbon dioxide separation composite according to any one of claims 1 to 6, ~~helically~~ spirally wound around a porous hollow central pipe.

~~8. A method for producing a composite for carbon dioxide separation, the method comprising:~~

~~a carbon dioxide separation layer formation process for coating an aqueous solution containing a water absorptive polymer and a carbon dioxide carrier onto a gas permeable support, drying the coating, and forming a carbon dioxide separation layer; and~~

~~a porous protective layer formation process for laminating a steam permeable porous protective layer having an average thickness of from 1 μm to 500 μm onto the carbon dioxide separation layer.~~

~~9~~8. A method for producing a composite for carbon dioxide separation, the method comprising:

a carbon dioxide separation layer formation process for coating an aqueous solution containing a water absorptive polymer and a carbon dioxide carrier onto a gas permeable support, drying the coating, and forming a carbon dioxide separation layer;

a porous protective layer formation process for laminating a steam permeable porous protective layer having an average thickness of from 1 μm to 500 μm onto the carbon dioxide separation layer; and

a supplied gas passage member formation process for bonding the supplied gas passage member, which is a net-like member having a mesh opening of from 30μm to 2000 μm, onto the porous protective layer.