DESCRIPTION

Title of Invention

TREATMENT APPARATUS AND TREATMENT METHOD FOR RAW MATERIAL

Technical Field

[0001] The present invention relates to a technique for treating a raw material, such as combustible waste, and more particularly to combustion, pyrolysis, and gasification treatment techniques that do not emit carbon dioxide into the atmosphere.

Background Art

[0002] Since carbon dioxide (CO_2) may be cause of global warming, it is required to reduce an amount of emission of the carbon dioxide. However, various combustion apparatuses, such as waste treatment systems, inevitably generate the carbon dioxide when combustible materials are combusted. Therefore, it has become an important issue to reduce the amount of emission of the carbon dioxide into the atmosphere.

[0003] On the other hand, an attempt has been made to recover the carbon dioxide discharged from the combustion apparatus and store the carbon dioxide in the ground, etc. However, in order to recover high-concentration carbon dioxide, it is necessary to completely combust a combustion exhaust gas containing the carbon dioxide discharged from the combustion apparatus with oxygen, or to separate the carbon dioxide from the combustion exhaust gas. Such a treatment cycle may require additional equipment and may increase costs.

Citation List

Patent Literature

[0004] Patent document 1: Japanese laid-open patent publication No. 2018-165388

Summary of Invention

Technical Problem

[0005] Therefore, the claimed invention provides a treatment apparatus and a treatment method capable of theoretically reducing an amount of carbon dioxide emitted into the

atmosphere to zero and capable of contributing to prevention of global warming.

Solution to Problem

[0006] According to a first aspect of the present invention, there is provided a treatment apparatus for a raw material, comprising: a fluidized-bed furnace having a pyrolysis chamber and a combustion chamber therein, the pyrolysis chamber and the combustion chamber being separated by a partition wall; an electrolysis device configured to electrolyze water to generate hydrogen and oxygen; a methanation reactor configured to produce methane from carbon dioxide discharged from the combustion chamber and the hydrogen; a first fluidizing-gas supply line configured to supply a first fluidizing gas to the pyrolysis chamber; a second fluidizing-gas supply line configured to introduce a second fluidizing gas to the combustion chamber, the second fluidizing gas including the oxygen and a part of the carbon dioxide; a hydrogen holder configured to store the hydrogen generated by the electrolysis device, the hydrogen holder being arranged between the electrolysis device and the methanation reactor; a hydrogen flow-rate control valve located between the hydrogen holder and the methanation reactor; and a controller configured to regulate an opening degree of the hydrogen flow-rate control valve based on a measured value of the flow rate of the carbon dioxide flowing into the methanation reactor, to thereby control a flow rate of the hydrogen delivered to the methanation reactor.

[0006A] According to a second aspect of the present invention, there is provided a treatment apparatus for a raw material, comprising: a fluidized-bed furnace having a pyrolysis chamber and a combustion chamber formed therein, the pyrolysis chamber and the combustion chamber being separated by a partition wall inside the fluidized bed furnace; an electrolysis device configured to electrolyze water to generate hydrogen and oxygen; a methanation reactor configured to produce methane from carbon dioxide discharged from the combustion chamber and the hydrogen; a first fluidizing-gas supply line configured to supply a first fluidizing gas to the pyrolysis chamber; a second fluidizing-gas supply line configured to introduce a second fluidizing gas to the

combustion chamber, the second fluidizing gas including the oxygen and a part of the carbon dioxide; an oxygen holder configured to store the oxygen generated by the electrolysis device, the oxygen holder being arranged between the electrolysis device and the combustion chamber; an oxygen flow-rate control valve located between the oxygen holder and the combustion chamber; and a controller configured to regulate an opening degree of the oxygen flow-rate control valve and thus a flow rate of the oxygen to the combustion chamber so as to maintain a temperature in the combustion chamber within a predetermined range.

[0007] In an embodiment, the electrolysis device is electrically connected to a CO_2-free power generator.

In an embodiment, the first fluidizing-gas supply line comprises an oxygen-free-gas supply line configured to supply oxygen-free gas as the first fluidizing gas into the pyrolysis chamber.

In an embodiment, the treatment apparatus further comprises a hydrogen holder configured to store the hydrogen generated by the electrolysis device, wherein the hydrogen holder is arranged between the electrolysis device and the methanation reactor.

In an embodiment, the treatment apparatus further comprises an oxygen holder configured to store the oxygen generated by the electrolysis device, wherein the oxygen holder is arranged between the electrolysis device and the combustion chamber.

[0008] In an embodiment, there is provided a method of treating a raw material using a fluidized-bed furnace having a pyrolysis chamber and a combustion chamber therein, the pyrolysis chamber and the combustion chamber being partitioned by a partition wall, said method comprising: electrolyzing water to generate hydrogen and oxygen; supplying a first fluidizing gas to the pyrolysis chamber, while moving a fluidized medium in the

combustion chamber to the pyrolysis chamber; pyrolyzing the raw material in the pyrolysis chamber; combusting a residue of the raw material in the combustion chamber; producing methane from carbon dioxide discharged from the combustion chamber and the hydrogen; and supplying a second fluidizing gas to the combustion chamber, the second fluidizing gas including the oxygen and a part of the carbon dioxide.

[0009] In an embodiment, the electrolysis of the water is performed using CO_2-free electric power.

In an embodiment, the first fluidizing gas is an oxygen-free gas.

Advantageous Effects of Invention

[0010] According to the claimed invention, the carbon dioxide discharged from the combustion chamber reacts with the hydrogen generated by the electrolysis device to generate the methane. Therefore, the treatment apparatus and the treatment method according to the claimed invention can theoretically reduce an amount of the carbon dioxide emitted into the atmosphere to zero.

Brief Description of Drawings

[0011]

[FIG. 1] FIG. 1 is a diagram showing an embodiment of a treatment apparatus;

[FIG. 2] FIG. 2 is a diagram showing another embodiment of the treatment apparatus; and

[FIG. 3] FIG. 3 is a diagram showing still another embodiment of the treatment apparatus.

Description of Embodiments

[0012] Embodiments of the present invention will now be described with reference to the drawings.

FIG. 1 is a diagram showing an embodiment of a treatment apparatus for treating a raw material, such as combustible waste. The treatment apparatus shown in FIG. 1 includes a fluidized-bed furnace 1 which is an incinerator for the raw material, an electrolysis device 2 configured to electrolyze water to generate hydrogen and oxygen, and a methanation reactor 3 configured to produce methane from carbon dioxide

CLAIMS

[Claim 1] A treatment apparatus for a raw material, comprising:

a fluidized-bed furnace having a pyrolysis chamber and a combustion chamber formed therein, the pyrolysis chamber and the combustion chamber being separated by a partition wall inside the fluidized-bed furnace;

an electrolysis device configured to electrolyze water to generate hydrogen and oxygen;

a methanation reactor configured to produce methane from carbon dioxide discharged from the combustion chamber and the hydrogen;

a first fluidizing-gas supply line configured to supply a first fluidizing gas to the pyrolysis chamber;

a second fluidizing-gas supply line configured to introduce a second fluidizing gas to the combustion chamber, the second fluidizing gas including the oxygen and a part of the carbon dioxide

a hydrogen holder configured to store the hydrogen generated by the electrolysis device, the hydrogen holder being arranged between the electrolysis device and the methanation reactor;

a hydrogen flow-rate control valve located between the hydrogen holder and the methanation reactor; and

a controller configured to regulate an opening degree of the hydrogen flow-rate control valve based on a measured value of the flow rate of the carbon dioxide flowing into the methanation reactor, to thereby control a flow rate of the hydrogen delivered to the methanation reactor.

[Claim 2] A treatment apparatus for a raw material, comprising:

a fluidized-bed furnace having a pyrolysis chamber and a combustion chamber formed therein, the pyrolysis chamber and the combustion chamber being separated by a partition wall inside the fluidized bed furnace;

an electrolysis device configured to electrolyze water to generate hydrogen and oxygen;

a methanation reactor configured to produce methane from carbon dioxide discharged from the combustion chamber and the hydrogen;

a first fluidizing-gas supply line configured to supply a first fluidizing gas to the pyrolysis chamber;

a second fluidizing-gas supply line configured to introduce a second fluidizing gas to the combustion chamber, the second fluidizing gas including the oxygen and a part of the carbon dioxide;

an oxygen holder configured to store the oxygen generated by the electrolysis device, the oxygen holder being arranged between the electrolysis device and the combustion chamber;

an oxygen flow-rate control valve located between the oxygen holder and the combustion chamber; and

a controller configured to regulate an opening degree of the oxygen flow-rate control valve and thus a flow rate of the oxygen to the combustion chamber so as to maintain a temperature in the combustion chamber within a predetermined range.

[Claim 3] The treatment apparatus according to claim 1 or 2, wherein the electrolysis device is electrically connected to a CO_2-free power generator.

[Claim 4] The treatment apparatus according to claim 1 or 2, wherein the first fluidizing-gas supply line comprises an oxygen-free-gas supply line configured to supply oxygen-free gas as the first fluidizing gas into the pyrolysis chamber.

[Claim 5] The treatment apparatus according to claim 2, further comprising:

a hydrogen holder configured to store the hydrogen generated by the electrolysis device, the hydrogen holder being arranged between the electrolysis device and the

methanation reactor; and

a hydrogen flow-rate control valve located between the hydrogen holder and the methanation reactor;

wherein the controller is further configured to regulate an opening degree of the hydrogen flow-rate control valve based on a measured value of the flow rate of the carbon dioxide flowing into the methanation reactor, to thereby control a flow rate of the hydrogen delivered to the methanation reactor.

[Claim 6] The treatment apparatus according to claim 1, further comprising:

an oxygen holder configured to store the oxygen generated by the electrolysis device, the oxygen holder being is arranged between the electrolysis device and the combustion chamber; and

an oxygen flow-rate control valve located between the oxygen holder and the combustion chamber;

wherein the controller is further configured to regulate an opening degree of the oxygen flow-rate control valve and thus a flow rate of the oxygen to the combustion chamber so as to maintain a temperature in the combustion chamber within a predetermined range.

[Claim 7] The treatment apparatus according to any one of claims 1 to 6, further comprising:

a product-gas delivery line coupled to a product-gas outlet of the pyrolysis chamber; and

a product-gas return line extending from the product-gas delivery line to the first fluidizing-gas supply line.

[Claim 8] The treatment apparatus according to any one of claims 1 to 6, further comprising:

a methane delivery line configured to deliver the methane produced by the methanation reactor; and

a methane return line extending from the methane delivery line to the first fluidizing-gas supply line.