CITATION LIST

PATENT DOCUMENT

[0004]

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SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0005]

However, adsorbents have different adsorption properties (adsorption isotherms) depending on their materials, and such a known humidity-controlling device does not perform heat source control considering the adsorption property for each adsorbent. Thus, energy efficiency has room for improvement.

[0006]

Embodiments of the present disclosure improve energy efficiency of the humidity-controlling device using an adsorbent that adsorbs moisture in the air.

SOLUTION TO THE PROBLEM

[0007]

According to an aspect of the present disclosure, there is provided a humidity-controlling device using an adsorbent which adsorbs moisture in air, the humidity-controlling device including: a control unit configured to control a temperature of the adsorbent or a relative humidity of air supplied to the adsorbent. When, in an adsorption isotherm of the adsorbent, a range less than a first relative humidity value is a first range, a range equal to or higher than the

first relative humidity value and equal to or lower than a second relative humidity value (the second relative humidity value > the first relative humidity value) is a second range, and a range exceeding the second relative humidity value is a third range, a change in moisture content of the adsorbent to a change in relative humidity in the second range is larger than a change in moisture content of the adsorbent to a change in relative humidity in the first range and the third range. The control unit causes the adsorbent to desorb moisture in a vicinity of the first relative humidity value and cause the adsorbent to adsorb moisture in a vicinity of the second relative humidity value.

[0008]

In the above aspect, the control unit controls a temperature of the adsorbent or a relative humidity of the air supplied to the adsorbent, considering the adsorption property of the adsorbent. This makes it possible to reduce a temperature variation width of the heat source for realizing the relative humidity range in which a required adsorption amount is obtained in the adsorbent, thereby improving energy efficiency.

[0009]

In an embodiment of the above aspect, a slope of the adsorption isotherm of the adsorbent in the second range is five times or more a slope of the adsorption isotherm of the adsorbent in the first range and the third range.

[0010]

The above embodiment allows further improvement in energy efficiency.

[0011]

In an embodiment of the above aspect, a variation in moisture content of the adsorbent in the second range is 50% or more of a maximum moisture content of the adsorbent.

[0012]

The above embodiment allows further improvement in energy efficiency.

[0013]

In an embodiment of the above aspect, a difference between the second relative humidity value and the first relative humidity value is 40% or less.

[0014]

The fourth aspect allows further improvement in energy efficiency.

[0015]

In an embodiment of the above aspect, the vicinity of the first relative humidity value is a range from –10% of the first relative humidity value to the first relative humidity value, and the vicinity of the second relative humidity value is a range from the second relative humidity value to +10% of the second relative humidity value.

[0016]

The above embodiment allows heat source control in consideration of the adsorption property of the adsorbent, thereby keeping energy efficiency from decreasing.

[0017]

In an embodiment of the above aspect, the adsorbent has a metal organic framework.

[0018]

The above embodiment allows an adsorbent having desired adsorption property to be obtained.

[0019]

In an embodiment of the above aspect, the humidity-controlling device further includes: an adsorption desorption unit including the adsorbent and configured to adsorb

moisture in target air and desorb the moisture adsorbed; a heat source configured to control a relative humidity at which the adsorption desorption unit adsorbs and desorbs moisture; a fan configured to control airflow of the target air; and an acquisition unit configured to acquire temperature-humidity data of the target air. The control unit controls a temperature of the heat source based on the temperature-humidity data acquired by the acquisition unit.

[0020]

The above embodiment allows temperature control of the heat source to achieve a relative humidity range in which a required adsorption amount is obtained in the adsorbent.

[0021]

In an embodiment of the above aspect, the adsorption isotherm of the adsorbent includes an adsorption line when moisture is adsorbed, and a desorption line when adsorbed moisture is desorbed, the adsorption desorption unit includes: an adsorption unit configured to adsorb moisture in the target air; and a desorption unit configured to desorb moisture adsorbed, the heat source includes a first heat source configured to control a relative humidity at which the adsorption unit adsorbs moisture; and a second heat source configured to control a relative humidity at which the desorption unit desorbs moisture, the control unit controls a temperature of the second heat source such that moisture is desorbed from the desorption unit in the vicinity of the first relative humidity value in the desorption line, and controls a temperature of the first heat source such that the adsorption unit adsorbs moisture in the vicinity of the second relative humidity value in the adsorption line.

[0022]

The above embodiment allows moisture to be desorbed from the adsorbent in the desorption unit in the vicinity of the first relative humidity value, and allows the adsorbent in

the adsorption unit to adsorb moisture in the vicinity of the second relative humidity value.

[0023]

In an embodiment of the above aspect, when a room is dehumidified, based on temperature-humidity data of first target air supplied into the room from outside and a second target air exhausted out of the room from inside, the control unit performs control to lower a temperature of the first heat source such that a relative humidity of the first target air reaching the adsorption unit has a value in the vicinity of the second relative humidity value in the adsorption line, and to increase a temperature of the second heat source such that a relative humidity of the second target air reaching the desorption unit has a value in the vicinity of the first relative humidity value in the desorption line, thereby supplying the first target air into the room as dehumidified air and making the second target air into high-humidity air to be exhaust out of the room.

[0024]

In the above embodiment, energy efficiency in the dehumidification of the room is improved.

[0025]

In an embodiment of the above aspect, when a room is humidified, based on temperature-humidity data of the first target air exhausted out of the room from inside and the second target air supplied into the room from outside, the control unit increases a temperature of the second heat source such that a relative humidity of the second target air reaching the desorption unit has a value in the vicinity of the first relative humidity value in the desorption line, and lowers a temperature of the first heat source such that a relative humidity of the first target air reaching the adsorption unit has a value in the vicinity of the second relative humidity

value in the adsorption line, thereby supplying the second target air into the room as humidified air and making the first target air into low-humidity air to be exhausted out of the room.

[0026]

In the above embodiment, energy efficiency in humidification of the room is improved.

[0027]

In an embodiment of the above aspect, the first heat source and the second heat source constitute a heat pump, and the control unit controls a temperature of the first heat source and a temperature of the second heat source in a coordinated manner.

[0028]

The above embodiment allows further improvement in energy efficiency.

[0029]

In an embodiment of the above aspect, the first heat source and the second heat source do not constitute a heat pump, and the control unit independently controls a temperature of the first heat source and a temperature of the second heat source.

[0030]

The above embodiment allows simplification of the humidity-controlling device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]