CLAIMS

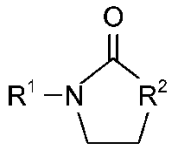
[Claim 1]

A composite amine absorbent to absorb at least one of CO_2 and H_2S in a gas, the composite amine absorbent comprising:

a chain monoamine (a);

a diamine (b);

a cyclic compound (c) represented by following chemical formula:



where R^1: any one of hydrogen, a hydrocarbon group having a carbon number of 1 to 4, and a hydroxyalkyl group,
R^2: oxygen or N-R^3, and
R^3: any one of hydrogen and a hydroxyalkyl group; and

water (d), wherein

the diamine (b) comprises at least one diamine containing amino groups having a same number of substituents,

a concentration of the chain monoamine (a) is 15% by weight or more and 60% by weight or less relative to the entire absorbent,

a concentration of the diamine (b) is 1% by weight or more and 25% by weight or less relative to the entire absorbent, and

a concentration of the cyclic compound (c) of the formula is 1% by weight or more and 30% by weight or less relative to the entire absorbent.

[Claim 2]

The composite amine absorbent according to claim 1,

wherein the chain monoamine (a) comprises at least one of a primary chain monoalkanolamine, a secondary chain monoalkanolamine, and a tertiary chain monoalkanolamine.

[Claim 3]

The composite amine absorbent according to claim 1, wherein the diamine containing amino groups having the same number of substituents comprises at least one of a primary chain polyamine, a secondary chain polyamine, and a secondary cyclic polyamine.

[Claim 4]

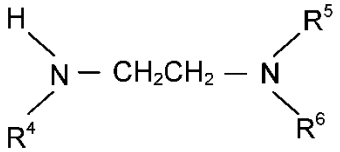
The composite amine absorbent according to claim 1, wherein the diamine (b) comprises at least one diamine containing amino groups having a same number of substituents and at least one chain diamine containing amino groups having different numbers of substituents.

[Claim 5]

The composite amine absorbent according to claim 4, wherein the diamine containing amino groups having the same number of substituents comprises at least one of a primary chain polyamine, a secondary chain polyamine, and a secondary cyclic polyamine.

[Claim 6]

The composite amine absorbent according to claim 4, wherein the chain diamine containing amino groups having the different numbers of substituents comprises at least one compound satisfying:



where R^4: any one of hydrogen, a hydrocarbon group having a carbon number of 1 to 4, and a hydroxyalkyl group,
R^5: any one of hydrogen, a hydrocarbon group having a carbon number of 1 to 4, and a hydroxyalkyl group, and
R^6: a hydroxyalkyl group, and
wherein for R^4 not being hydrogen, R^5 is also not hydrogen.

[Claim 7]

The composite amine absorbent according to claim 1, wherein a total concentration of the chain monoamine (a), the diamine (b), and the cyclic compound (c) of the chemical formula is 20% by weight or more and 80% by weight or less relative to the entire absorbent.

[Claim 8]

The composite amine absorbent according to claim 1, wherein a weight ratio of ((diamine (b) + cyclic compound (c) of chemical formula)/(chain monoamine (a))) is $0.033 \leq (b + c)/a \leq 3.7$.

[Claim 9]

The composite amine absorbent according to claim 1, wherein a weight ratio of diamine (b)/cyclic compound (c) of chemical formula is a blend of $0.033 \leq b/c \leq 18$.

[Claim 10]

A removal unit using the composite amine absorbent according to any one of claims 1 to 9, the removal unit comprising:

an absorber configured to bring a gas including at least one of CO_2 and H_2S into contact with the absorbent to remove at least one of CO_2 and H_2S; and

an absorbent regenerator configured to regenerate a

solution absorbing at least one of CO_2 and H_2S,

wherein the regenerated solution formed by removing at least one of CO_2 and H_2S in the absorbent regenerator is reused in the absorber.

[Claim 11]

The removal unit according to claim 10, wherein

the absorber has an absorbing temperature of 30°C to 80°C, and

the absorbent regenerator has a regeneration temperature of 110°C or more.

[Claim 12]

A removal method using the composite amine absorbent according to any one of claims 1 to 9, the removal method comprising:

bringing a gas including at least one of CO_2 and H_2S into contact with the absorbent to remove at least one of CO_2 and H_2S in an absorber;

regenerating a solution absorbing at least one of CO_2 and H_2S in an absorber regenerator; and

reusing in the absorber the solution regenerated by removing at least one of CO_2 and H_2S in the absorbent regenerator.

[Claim 13]

The removal method according to claim 12, wherein

an absorbing temperature in the absorber is 30°C to 80°C; and

a regeneration temperature in the absorbent regenerator is 110°C or more.