

CLAIMS

1. A method for capturing carbon dioxide from flue gas by using active sodium carbonate, the method being a reprocessing of the flue gas of power plant boilers after common dust removal and desulfurization treatment; **characterized in that:** the method comprises the following steps:
 - 1) mixing an aqueous solution of sodium carbonate with an amino alcohol activator to yield a CO₂ absorbent; evenly spraying the CO₂ absorbent into the flue gas after the common dust removal and desulfurization treatment for fully contacting the flue gas flowing upwardly with the downwardly sprayed CO₂ absorbent and for allowing CO₂ in the flue gas to react with the amino alcohol activator and the aqueous solution of sodium carbonate: the amino alcohol activator first contacting with CO₂ to form a zwitterionic intermediate and being free again in a consequent hydration reaction of the zwitterionic intermediate, H⁺ produced from the hydration reaction being neutralized by alkali ion CO₃²⁻ in the aqueous solution of sodium carbonate, and HCO₃⁻ produced from the hydration reaction contacting with metal ion Na⁺ in the aqueous solution of sodium carbonate and precipitating to produce a sodium bicarbonate slurry;

wherein a concentration of the aqueous solution of sodium carbonate is 10-30 wt. %;

the amino alcohol activator is monoethanolamine or diethanolamine;

a weight of monoethanolamine or diethanolamine being added is 0.5-6% of a weight of sodium carbonate being added; and

a circulating liquid-gas ratio between a whole solution of the CO₂ absorbent and the flue gas is 5-25 L/m³;

- 2) thermal decomposing the sodium bicarbonate slurry obtained in step 1) to produce a high concentrated CO₂ gas and an aqueous solution of sodium carbonate;
- 3) returning the aqueous solution of sodium carbonate obtained in step 2) to step 1) to form the CO₂ absorbent for recycling;
- 4) cooling the high concentrated CO₂ gas separated from step 2) for condensing hot water vapor therein;
- 5) carrying out gas-liquid separation on the high concentrated CO₂ gas after cooling treatment of step 4), removing condensed water to yield high purified CO₂ gas having a purity exceeding 99%; and
- 6) drying, compressing, and condensing the high purified CO₂ gas obtained from step 5) to transform the high purified CO₂ gas into a liquid state, whereby obtaining high concentrated liquid CO₂.

2. ~~The method of claim 1, characterized in that in step 1),~~

~~a concentration of the aqueous solution of sodium carbonate is 10-30 wt. %;~~

~~the amino alcohol activator is monoethanolamine or diethanolamine;~~

~~a weight of monoethanolamine or diethanolamine being added is 0.5-6% of a weight of sodium carbonate being added; and~~

~~a circulating liquid-gas ratio between a whole solution of the CO₂ absorbent and the flue gas is 5-25 L/m³.~~

~~3.2.~~ 3.2. The method of claim 1 ~~or 2~~, **characterized in that** a temperature of the reaction between CO₂ in the flue gas and the CO₂ absorbent in step 1) is controlled at 40-55°C; and a pressure of the reaction is controlled at 3-300 kPa.

~~4.3.~~ 4.3. The method of claim 1 ~~or 2~~, **characterized in that** a temperature of the thermal decomposition of the sodium bicarbonate slurry in step 2) is controlled at 80-130°C.

~~5.4.~~ 5.4. The method of claim 1 ~~or 2~~, **characterized in that** the high concentrated CO₂ gas is cooled to a temperature of 20-35°C.

~~6.5.~~ 6.5. An apparatus for capturing carbon dioxide from flue gas by using active sodium carbonate according to the method of claim 1, the apparatus comprising:

- a) an absorption tower (1);
- b) a regeneration tower (10);
- c) a cooler (17);
- d) a gas-liquid separator (16);
- e) a desiccator (15);
- f) a compressor (14); and
- g) a condenser (13);

characterized in that

a plurality of absorbent spray layers (20) and at least one demister

device (21) are arranged one after another from bottom to top between a lower flue gas inlet (5) and a top flue gas outlet (22) of the absorption tower (1);

a bottom slurry outlet of the absorption tower (1) communicates with an upper slurry inlet (6a) of a slanting board sedimentation pool (6); an upper absorbent inlet (6b) of the slanting board sedimentation pool (6) communicates with an absorbent container (19);

a supernatant outlet (6c) of the slanting board sedimentation pool (6) is connected to the absorbent spray layers (20) of the absorption tower (1) via an absorbent circulating pump (8);

an underflow outlet (6d) of the slanting board sedimentation pool (6) is connected to an upper feed inlet of the regeneration tower (10) via a sodium bicarbonate pump (7); a lower feed outlet of the regeneration tower (10) is connected to the upper absorbent inlet (6b) of the slanting board sedimentation pool (6) via a sodium carbonate pump (9); and

an upper decomposed gas outlet of the regeneration tower (10) is connected to an inlet of the gas-liquid separator (16) via the cooler (17); a gas outlet of the gas-liquid separator (16) is in series connected with the desiccator (15), the compressor (14), and the condenser (13);

wherein three absorbent spray layers (20) are employed;

a filler layer (3) is arranged beneath a highest absorbent spray layer (20);

and

a uniform flow sieve plate (4) is arranged beneath each of the other two absorbent spray layers (20).

~~7.6.~~ The apparatus of claim ~~65~~, **characterized in that**

the underflow outlet (6d) of the slanting board sedimentation pool (6) is connected to the upper feed inlet of the regeneration tower (10) via the sodium bicarbonate pump (7) and a heat exchanger (18); and

the lower feed outlet of the regeneration tower (10) is connected to the upper absorbent inlet (6b) of the slanting board sedimentation pool (6) via the sodium carbonate pump (9) and the heat exchanger (18).

~~8.7.~~ The apparatus of claim ~~65 or 7~~, **characterized in that** a liquid outlet of the gas-liquid separator (16) is connected to the upper absorbent inlet (6b) of the slanting board sedimentation pool (6).

~~9.~~ ~~The apparatus of claim 6 or 7, characterized in that~~

~~three absorbent spray layers (20) are employed;~~

~~a filler layer (3) is arranged beneath a highest absorbent spray layer (20);~~

~~and~~

~~a uniform flow sieve plate (4) is arranged beneath each of the other two absorbent spray layers (20).~~

~~10.8.~~ The apparatus of claim ~~95~~, **characterized in that** a ratio between an aperture area and a plate area of the uniform flow sieve plate (4) is 30-40%.