

CLAIMS:

1. A method for recovering a solvent from a decarbonated flue gas in a water wash section of an absorption column, the decarbonated flue gas having had carbon dioxide absorbed and removed by vapor-liquid contact with a carbon dioxide absorbing solution
5 containing the solvent in the absorption column, the method comprising:

bringing a water stream substantially free of the solvent into counter-current contact with the decarbonated flue gas in an emission control section of the absorption column to recover the solvent from the decarbonated flue gas to form a solvent containing wash water and a reduced solvent containing flue gas; and

10 bringing a cooled wash water into counter-current contact with the reduced solvent containing flue gas in a flue gas cooling section of the absorption column to cool the reduced solvent containing flue gas, thereby forming a cooled flue gas and a used wash water.

2. A method according to claim 1, wherein the solvent is an amine-containing solution.

15 3. A method according to claim 1 or 2, further comprising:

adjusting an amount of solvent absorbed by the wash water section by adjusting an amount of the water stream contacted with the decarbonated flue gas; and

adjusting an amount of water removed from the reduced solvent containing flue gas by adjusting a temperature of the cooled wash water contacted with the reduced
20 solvent containing flue gas.

4. A method according to any one of claims 1 to 3, further comprising:

collecting the used wash water with a collection device disposed between the flue gas cooling section and the emission control section;

removing the collected used wash water from the collection device;

cooling at least a portion of the removed used wash water to form cooled wash water; and

returning at least a portion of the cooled wash water to the flue gas cooling section.

5 5. A method according to claim 4, further comprising;

adjusting an amount of used wash water removed from the flue gas cooling section by adjusting an amount of cooled wash water returned to the flue gas cooling section.

6. A method according to claim 5, further comprising;

10 adjusting an amount of water removed from the decarbonated flue gas in the flue gas cooling section by adjusting a temperature of the cooled wash water brought into contact with the reduced solvent containing flue gas.

7. A method according to any one of claims 1 to 6, further comprising:

collecting the used wash water with a collection device disposed between the flue gas cooling section and the emission control section;

15 removing the collected used wash water from the collection device; and

providing at least a portion of the removed used wash water to the emission control section.

8. A method according to claim 7, further comprising:

providing a remainder of the removed used wash water to a heat exchanger;

20 cooling the removed used wash water to form a cooled wash water; and

providing the cooled wash water to the flue gas cooling section.

9. A method according to claim 7 or 8, further comprising:

contacting the decarbonated flue gas with the removed used wash water and the water stream in a countercurrent manner in the emission to form a solvent containing wash water.

10. A method according to claim 9, further comprising:

5 collecting the solvent containing wash water in a collection device within the emission control section; and

reutilizing at least a portion of the solvent containing wash water in the emission control section.

11. A method according to claim 10, wherein the portion of the solvent containing
10 wash water reutilized in the emission control section is combined with the used wash water from the flue gas cooling section; and

providing the combined solvent containing wash water and used wash water to the emission control section.

12. A method according to claim 10 or 11, further comprising:

15 providing at least a portion of the solvent containing wash water to an absorber bed in the absorption column.

13. A system for recovering a solvent from a decarbonated flue gas in an absorption column, the decarbonated flue gas having had carbon dioxide absorbed and removed by vapor-liquid contact with a carbon dioxide absorbing solution containing the
20 solvent, the system comprising:

an emission control section configured to bring a water stream substantially free of the solvent into contact with the decarbonated flue gas to recover the solvent from the decarbonated flue gas and to form a solvent containing wash water and a reduced solvent containing flue gas; and

a flue gas cooling section configured to bring cooled wash water into contact with the reduced solvent containing flue gas to cool the reduced solvent containing flue gas and condense water from the decarbonated flue gas thereby forming a cooled flue gas and used wash water.

5 14. A system according to claim 13, wherein the solvent is an amine compound.

15. A system according to claim 13 or 14, further comprising:

a controller configured to adjust an amount of solvent absorbed in the emission control section by adjusting an amount of the water stream contacted with the decarbonated flue gas.

10 16. A system according to claim 15, wherein the controller is configured to adjust an amount of water removed from the reduced solvent containing flue gas by adjusting a temperature of the cooled wash water contacted with the reduced solvent containing flue gas.

17. A system according to any one of claims 13 to 16, further comprising:

15 a collection device disposed between the flue gas cooling section and the emission control section, the collection device configured to collect the used wash water from the flue gas cooling section;

a pump in fluid communication with a sump of the collection device to remove the collected used wash water from the collection device;

20 a heat exchanger in fluid communication with the pump to cool at least a portion of the removed used wash water to form a cooled wash water; and

a liquid distributor disposed in the absorption column and in fluid communication with the heat exchanger, the liquid distributor configured to distribute the cooled wash water in the flue gas cooling section.

18. A system according to claim 17, further comprising:

a second liquid distributor disposed in the absorption column and in fluid communication with the pump, the second liquid distributor configured to distribute at least a portion of the removed used wash water in the emission control section.

19. A system according to claim 18, further comprising:

5 a collection device disposed between the emission control section and an absorber bed, the collection device configured to collect the solvent containing wash water from the emission control section;

a pump in fluid communication with a sump of the collection device to remove the collected solvent containing wash water from the emission control section; and

10 a line to direct at least a portion of the removed solvent containing wash water to the second liquid distributor.

20. A system according to claim 19, further comprising:

15 a recycle liquid provided to the second liquid distributor, wherein the recycle liquid includes at least a portion of the removed solvent containing wash water from the emission control section and at least a portion of the used wash water from the flue gas cooling section.

21. A method according to claim 1, wherein the bringing of the water stream into countercurrent with the decarbonated flue gas further includes:

20 providing sufficient water stream to reduce the solvent in the flue gas to be substantially low when exiting the emission control section.

22. A method according to claim 21, wherein the bringing of the water stream into countercurrent with the decarbonated flue gas further includes:

providing the water stream at a temperature such that the temperature difference between the entrance and the exit of the emission control section is minimal.

23. A method according to claim 1, further comprising:

adjusting the temperature within the emission control section so that the temperature difference of the flue gas between the entrance and the exit of the emission control section is minimal.

5 24. A method according to claim 1, further comprising:

adjusting the concentration gradient of solvent between the water stream and the decarbonated flue gas in the emission control section to reduce the water stream circulation rate to provide a minimal temperature difference of the flue gas between the entrance and the exit of the emission control section.

10 25. A method according to claim 1, wherein the solvent removed in the flue gas cooling section is minimal.

26. A method according to claim 7, further comprising:

adjusting the concentration gradient of solvent between the water stream and the decarbonated flue gas in the emission control section by adjusting the flow rate of the at
15 least portion of the removed used water to the emission control section.

27. A method according to claim 7, wherein the at least portion of the removed used wash water is provided to an upper portion of the emission control section.

28. A method according to claim 27, wherein the solvent removed in the flue gas cooling section is minimal.