CLAIMS

1. Process for manufacturing a sorbent suitable for a use in a circulating dry scrubber device comprising the steps of :

- providing quicklime and water in an hydrator;
- slaking said quicklime via a non-wet route in the hydrator ;
- collecting a lime based sorbent at an exit of the hydrator

characterized in that said process comprises a further step of adding at least a first additive comprising:

- a compound comprising silicon, selected among the group ~~comprising~~consisting of silicates of sodium, metasilicates, metasilicates of sodium, kieselguhr, diatomite, precipitated silica, silica fume, rice husk ash, silicic acid, amorphous silica or a combination thereof, and/or;
- a compound comprising aluminum selected among the group ~~comprising~~consisting of aluminum trihydroxide, boehmite or a combination thereof, and/or;
- a compound comprising silicon and aluminum selected among the group ~~comprising~~consisting of vermiculite, paper ash, or a combination thereof;

before or during said slaking step, at a molar ratio between silicon or aluminum or a combination thereof and the calcium provided to said hydrator equal to or below 0.2 and equal to or above 0.02.

2. Process according to claim 1, characterized in that said first additive is provided at least partially in a solution or in a suspension and added to said water.

3. Process according to claim 1 or 2, characterized in said first additive is provided at least partially under solid form and added to said quicklime.

4. Process according to any one of the preceding claims, characterized in that said first additive comprises at least 4 weight % of silicon or aluminum or of a combination thereof with respect to the total weight of said additive.

5. Process according to any one of the preceding claims, characterized in that said quicklime and said first additive are provided in a premix containing at least 50 weight % of quicklime and at least 0.7 weight % of silicon or aluminum or a combination thereof and at most 10 weight % of silicon or aluminum or a combination thereof with respect to said total weight of said premix under a dry form.

6. Process according to any one of the preceding claims, characterized in that said first additive further comprises sodium.

7. Process according to any one of the preceding claims, characterized in that it comprises an additional step of adding a second additive comprising a compound comprising sodium.

8. Process according to claim 7, characterized in that the said second additive is provided at least partially in a solution or in a suspension and added to the said water.

9. Process according to claim 7 or 8, characterized in that the said second additive is provided at least partially under solid form and added to the said quicklime.

10. Process according to any one of the claims 6 to 9, characterized in that the molar ratio between silicon or aluminum or the combination thereof and sodium is equal to or above 0.4 and of maximum 20.

11. Process according to any one of the preceding claims, characterized in that it further comprises a step of drying said lime based sorbent or classifying said lime based sorbent or grinding said lime based sorbent or milling said lime based sorbent or a combination thereof.

12. Process according to any one of the preceding claims, characterized in that said first additive comprises a pozzolan material.

13. Process according to any one of the claims 7 to 12 characterized in that the said second additive comprising a compound

comprising sodium is selected among the group of sodium hydroxide, sodium carbonate, sodium hydrogenocarbonate, sodium nitrate, sodium phosphate, sodium persulfate or sodium acetate.

14. Premix for a process according to any one of the claims 1 to 13, comprising quicklime and a first additive comprising:

- a compound comprising silicon, selected among the group ~~comprising~~consisting of silicates of sodium, metasilicates, metasilicates of sodium, kieselguhr, diatomite, precipitated silica, silica fume, silicic acid, amorphous silica, rice husk ash, or a combination thereof, and/or;
- a compound comprising aluminum selected among the group ~~comprising~~consisting of aluminum trihydroxide, boehmite or a combination thereof, and/or;
- a compound comprising silicon and aluminum selected among the group ~~comprising~~consisting of vermiculite, paper ash, or a combination thereof;

with a molar ratio between the silicon or aluminum or the combination thereof and the calcium equal to or below 0.2 and equal to or above 0.02.

15. Premix according to claim 14, characterized in that said additive further comprises sodium and/or in that said premix further comprises a second additive comprising a compound comprising sodium with a molar ratio between the silicon or aluminum or the combination thereof and the sodium is of at least 0.4 and of maximum 20.

16. Premix according to claim 14 or 15, characterized in that it comprises at least 50 weight % of quicklime and at least 0.7 weight % of silicon or aluminum or a combination thereof and at most 10 weight % of silicon or aluminum or a combination thereof with respect to the total weight of said premix under a dry form.

17. Sorbent suitable for a use in a circulating dry scrubber device comprising at least 50 weight % of $Ca(OH)_2$ and at least 0.5 weight % of silicon or aluminum or a combination thereof expressed under its elemental form and at most 8 weight % of silicon or aluminum or a combination thereof

expressed under their elemental form, with respect to the total weight of said sorbent under a dry form, characterized in that it further comprises 1 to 12 weight % of bound water with respect to the total weight of said sorbent under a dry form and in that from 1 to 40 mol % of calcium is neither under the form of $Ca(OH)_2$ nor $CaCO_3$ nor CaO, the said sorbent being obtained by the process according to any one of the claims 1 to 13.

18. Sorbent according to claim 17, characterized in that the molar ratio between silicon or aluminum or the combination thereof and calcium is of at least 0.02 and of maximum 0.2

19. Sorbent according to any one of the claims 17 or 18, characterized in that it further comprises at least 0.1 and at most 15 weight % of sodium expressed under its equivalent Na_2O oxide form with respect to the total weight of said sorbent under a dry form.

20. Sorbent according to claim 19, characterized in that the molar ratio between silicon or aluminum or a combination thereof and sodium is of at least 0.4 and of maximum 20.

21. Sorbent according to any one of the claims 17 to 20, characterized in that it has a specific surface area of at least 3 m^2/g and of maximum 25 m^2/g measured by manometry with adsorption of nitrogen after degasing in vacuum at 190°C for at least 2 hours and calculated according the multipoint BET method as described in the ISO 9277/2010E standard.

22. Sorbent according to any one of the claims 17 to 21, characterized in that it has a total pore volume of at least 0.01 cm^3/g and of maximum 0.15 cm^3/g determined by manometry with adsorption of nitrogen after degasing in vacuum at 190°C for at least 2 hours and calculated according the BJH method as described in the ISO 9277/2010E standard.

23. Use of a sorbent according to any one of the claims 17 to 22, in a circulating dry scrubber for a flue gas treatment process.

24. Process of flue gas treatment using a circulating dry scrubber device characterized in that it comprises a step of recirculating a sorbent according to any one of the claims 17 to 22~~ or obtained from a process according to any one of the claims 1 to 13~~, into the said circulating dry scrubber.

25. Process of flue gas treatment according to claim 24, characterized in that it comprised a step of introduction in said circulating dry scrubber device of a sorbent according to any one of the claims 17 to 22 ~~or obtained from a process according to any one of the claims 1 to 13~~.

26. Use of a premix according to claim 14 to 16 in a flue gas treatment process, wherein the said premix is slaked in a hydrator upstream of a circulating dry scrubber device.

27. Process ~~for~~of flue gas treatment according to claim 24 or 25 using a circulating dry scrubber installation wherein

i) a stream of flue gas comprising an acid gas pollutant is injected into a reactor with a temperature comprised between 120°C and 250°C;

ii) a fresh sorbent according to sorbent according to any one of the claims 17 to 22 ~~or obtained from a process according to any one of the claims 1 to 13~~

is injected into said reactor to react with said stream of flue gas to form residues and a stream of gas depleted in pollutants with a normalized stoichiometric ratio NSR comprised between 1 and 2.5, the normalized stoichiometric ratio being defined by the equation NSR = (Ca/N*P)

wherein Ca is the number of moles of Ca(OH)2 of the said fresh sorbent injected in the reactor,

P is the number of moles of pollutant from the said flue gas and ;

N is the stoichiometric number of moles of pollutants that can react with Ca(OH)2 according to the theoretical chemical reaction to completely convert one mole of a Ca(OH)2;

iii) said stream of gas depleted of pollutants and residues are directed towards a filter unit which separates said stream of gas depleted in pollutants from the residues;

iv) said residues are collected by a recycling system to be sent back to the reactor

v) said residues are conditioned with water;

characterized in that the amount of water used for conditioning said residues is superior to 10 w% of the circulating dry mass of residues when the raw gas contents less than 50 mg/Nm^3 of HCl and the amount of water used for conditioning said residues is superior to 5 w% of the dry circulating mass of residues when the raw gas contents more than 50 mg/Nm^3 of HCl, and is optimized to cool the said flue gas in the said reactor by evaporation of water from the said conditioned residues such that the said gas depleted of pollutants leaves the said reactor with a temperature decreased of at least 20°C, preferably at least 30°C, preferably at least 40°C, more preferably at least 50°C, in a range of temperatures inferior to 200°C and superior of 20°C to the acid dew point of the said acid pollutant in the said flue gas.

28. Process according to claim 27 wherein

- the composition of the flue gas and of the gas depleted in pollutant is monitored;

- the volume of sorbent including fresh sorbent or residues or a combination thereof circulating in the said circulating dry scrubber is fixed;

- the performance of removal of pollutants is evaluated and;

- in case of decrease of the said performance, the amount of said water for conditioning the said residue is increased to a maximum of 20 w% of the dry circulating mass of residues.

29. Process according to claim 27 or 28 wherein

- the composition of the flue gas and of the gas depleted in pollutant is monitored;

- the volume of sorbent including fresh sorbent or residues or a combination thereof circulating in the said circulating dry scrubber installation is fixed;
- the performance of removal of pollutants is evaluated and;
- in case of decrease of the said performance an appropriated amount of fresh sorbent is injected in the said circulating dry scrubber installation.