CLAIMS

1. Process for the decarbonation of limestone, dolomite or other carbonated materials, said process comprising the following steps:

- heating particles of carbonated materials ~~(6)~~ in a reactor ~~(8)~~ of a first circuit ~~(2)~~ up to a temperature range in which carbon dioxide of the carbonated materials is released to obtain decarbonated particles ~~(16)~~ comprising CaO and/or MgO;
- conveying particles of carbonated materials ~~(6)~~ by a first entraining gas ~~(4)~~ in the first circuit ~~(2)~~ for preheating said carbonated materials ~~(6)~~, said entraining gas ~~(4)~~ comprising said carbon dioxide, said gas composition being substantially free of nitrogen;
- separating the carbonated particles ~~(6)~~ from a first entraining gas ~~(4)~~ flow ;
- transferring the decarbonated particles ~~(16)~~ to a cooling section ~~(22)~~ of a second circuit ~~(12)~~ comprising a second entraining gas ~~(14)~~ in which the conveyed decarbonated particles ~~(16)~~ release a portion of their thermal energy;
- separating the decarbonated particles ~~(16)~~ from a second entraining gas ~~(14)~~ flow;

wherein said second entraining gas ~~(14)~~ is substantially free of carbon dioxide, and wherein the first ~~(2)~~ and second circuits ~~(12)~~ are separated by selective separation means ~~(20, 21)~~ allowing the passage of solids while substantially preventing the passage of the entraining gases ~~(4, 14)~~.

2. Process according to Claim 1, further comprising a step of introducing the particles of carbonated materials ~~(6)~~ in a pre-heating section ~~(42)~~ of the first circuit ~~(2)~~ so that said particles are pre-heated by the first entraining gas ~~(4)~~ by means of a solid-gas heat exchange ~~(44)~~.

3. Process according to any of the preceding claims, further comprising a step of introducing the particles of carbonated materials ~~(6)~~ in a heating section ~~(32)~~ of the second circuit ~~(12)~~, the heating section ~~(32)~~ being positioned downstream of the cooling section ~~(22)~~, so that the released heat from the decarbonated particles ~~(16)~~ to the second entraining gas ~~(14)~~ is used to heat the particles of carbonated materials ~~(6)~~ by means of a solid-gas heat exchange ~~(34)~~, the heated particles ~~(6)~~ being subsequently transferred to the reactor ~~(8)~~ or upstream of the pre-heating section ~~(42)~~.

4. Process according to any of the preceding claims, further comprising a step of separating the particles of carbonated materials ~~(6)~~ from a second entraining gas ~~(14)~~ flow.

5. Process according to any of the previous claims, further comprising a step of recirculating at least a portion of the carbon dioxide released in the reactor ~~(8)~~ in the first circuit ~~(2)~~, preferably recirculating said carbon dioxide to the reactor ~~(8)~~.

6. Process according to any of the previous claims, further comprising a step of separating at least one constituent, in particular water, from at least one portion of the first entraining gas ~~(4)~~ exiting the reactor ~~(8)~~.

~~**7.** Process according to any of the previous claims, wherein the carbon dioxide represents at least 50%, preferably at least 85% by volume of the first entraining dry gas composition exiting the reactor (8).~~

~~**8**~~**7.** Process according to any of the previous claims, further comprising a step of recycling at least a portion of the heat of the second entraining gas ~~(14)~~, preferably exchanging heat from the second entraining gas ~~(14)~~ to the first entraining gas ~~(4)~~, more preferably through a gas-gas heat exchanger ~~(60)~~ positioned between the first circuit ~~(2)~~ and the second circuit ~~(12)~~.

~~**9.** Process according to any of the previous claims, further comprising a step of controlling a louver or a damper in either the first circuit (2) or second circuit (12) so that the absolute pressure difference across the selective separation means (20) remains below a predefined value, preferably remains within a given pressure range.~~

~~**10.** Process according to any of the previous claims, wherein the reactor (8) is a first reactor (8, 82, 84), said process further comprising a step of extending decarbonation degree and/or adjusting the product reactivity, preferably extending the retention time of the decarbonated particles (16) in a second reactor (86).~~

~~**11.** Process according to any of the previous claims, further comprising a step of burning at least a portion of the second entraining gas (14) in a burner outside the reactor (8), said reactor (8) comprising an externally-fired calciner (84);~~

~~**12**. Process according to any of the previous claims, further comprising a step of using the thermal energy in flue gas from the externally-fired calciner to preheat at least a part of the carbonated material.~~

~~**13**~~**8**. Process according to any of the previous claims, further comprising a step of separating the particles ~~(16)~~ of decarbonated materials from a first entraining gas ~~(4)~~ flow.

~~**14**~~**9**. Process according to any of the previous claims, wherein the step of separating the carbonated particles ~~(6)~~ from a first entraining gas ~~(4)~~ flow comprises a step of inertially separating the carbonated particles ~~(6)~~ from the first entraining gas ~~(4)~~ flow.

~~15~~10. Process according to any of the previous claims, wherein the step of separating the decarbonated particles ~~(16)~~ from a second entraining gas ~~(14)~~ flow comprises a step of inertially separating the decarbonated particles ~~(16)~~ from the second entraining gas ~~(14)~~ flow.

~~16~~11. Process according to any of the previous claims, wherein the step of separating the particles ~~(6)~~ of carbonated materials from a second entraining gas ~~(14)~~ flow comprises a step of inertially separating the particles ~~(6)~~ of carbonated materials from the second entraining gas ~~(14)~~ flow.

~~17~~12. Process according to any of the previous claims, wherein the step of separating the particles ~~(16)~~ of decarbonated materials from a first entraining gas ~~(4)~~ flow comprises a step of inertially separating the particles ~~(16)~~ of decarbonated materials ~~(16)~~ from the first entraining gas ~~(4)~~ flow.

~~18~~13. Process according to any of the previous claims, wherein the particles of the carbonated ~~(6)~~ minerals have a d90 less than 10 mm, preferably less than 6 mm, more preferably less than 4 mm.

~~19~~14. Device for the decarbonation of limestone, dolomite or other carbonated materials, for carrying out the process according to any of the preceding claims comprising:

- a first circuit ~~(2)~~ in which a first entraining gas ~~(4)~~ substantially free of nitrogen conveys particles ~~(6)~~ of said carbonated mineral, said first circuit comprising a reactor ~~(8)~~ in which said particles ~~(6)~~ are heated to a temperature range in which carbon dioxide is released to obtain decarbonated particles comprising CaO and/or MgO;
- a second circuit ~~(12)~~ in which a second entraining gas ~~(14)~~ substantially free of carbon dioxide is circulated, the second circuit ~~(12)~~ comprising a cooling section ~~(22)~~ in which the decarbonated particles ~~(16)~~ transferred from the first circuit ~~(2)~~, release a portion of their thermal energy to the second entraining gas ~~(14)~~;
- at least one selective separation means ~~(20, 21)~~ connecting the first ~~(2)~~ and second circuits ~~(12)~~ arranged so as to allow the transfer of either the particles of carbonated materials or the decarbonated particles ~~(16)~~ of said materials between the first circuit and the second circuit while substantially preventing the passage of gases ~~(4, 14)~~, in particular a siphon element, a loop seal, single or multiple flaps, table feeder, cellular wheel sluice, fluid seal-pot, “Dollar” plate, or any of the following valves: rotary valves, cone valve, J valve, L valve, trickle valve and flapper valve; characterised in that the first circuit ~~(2)~~ comprises a pre-heating section ~~(42)~~, said pre-heating section comprising at least a first solid/gas

suspension heat exchanger (44) and/or a second solid/gas suspension exchanger (46), preferably said second solid/gas suspension exchanger (46) being positioned downstream from said first solid/gas suspension heat exchanger.

2015. Device according to Claim 1914, wherein the second circuit (12) comprises a heating section (32) positioned downstream from the cooling section (22) of the second circuit (2), preferably said cooling section (22) and heating section (32) each comprising a solid/gas suspension heat exchanger (24, 34).

21. Device according to any of Claims 19 to 20, wherein the first circuit (2) comprises a pre-heating section (42), said pre-heating section comprising at least a first solid/gas suspension heat exchanger (44) and/or a second solid/gas suspension exchanger (46), preferably said second solid/gas suspension exchanger (46) being positioned downstream from said first solid/gas suspension heat exchanger (44).

2216. Device according to any of Claims 19 14 to 2115, wherein a first selective separation means (20) connecting the first (2) and the second circuit (12) allowing the transfer of the decarbonated particles (16) from the first circuit (2) to the second circuit (12) while substantially preventing the passage of gases (4, 14), the first selective separation means (20) being connected upstream of an inlet (24.1) of the first suspension heat exchanger (24) of the second circuit (12).

2317. Device according to any of Claims 19 14 to 2215, comprising a second selective separation means (21), connecting the first (2) and the second (12) circuit allowing the transfer of the carbonate particles (6) from the second circuit (12) to the first circuit (2) while substantially preventing the passage of gases (4, 14), wherein a return passage (34.3) of the second solid/gas suspension heat exchanger (34) of the second circuit (12) is connected to the first circuit (2), preferably said selective separation means (21) being connected to the reactor (8) or upstream of an element of first circuit (2), said element being the first solid/gas suspension heat exchanger (44) or the second solid/gas suspension heat exchanger (46) .

2418. Device according to any of Claims 19 14 to 2315, wherein the reactor (8) comprises an externally-fired calciner (84), said externally-fired calciner (84) comprising an exhaust passage (100), said passage (100) being connected to the second circuit (12), preferably upstream of the heating section (32).

25. Device according to any of Claims 19 to 24, wherein the first solid/gas suspension heat exchanger (44) and/or the second solid/gas suspension exchanger (46) of the first circuit (2) comprise at least one separator, in particular a cyclone, the at least one separator comprising an inlet (44.1, 46.1), an outlet (44.2, 46.2) and a return passage (44.3, 46.3) for collecting the separated particles (6).

~~**26.** Device according to any of Claims 19 to 25, wherein the solid/gas suspension heat exchanger (24) of the cooling section (22) of the second circuit (12) and/or the solid/gas suspension exchanger (34) of the heating section (32) of the second circuit (12) comprise at least one separator, in particular an inertial separator, preferably a cyclone, the at least one separator comprising an inlet (24.1, 34.1), an outlet (24.2, 34.2) and a return passage (24.3, 34.4) for collecting the separated particles (16, 6).~~

~~**27.** Device according to any of Claims 19 to 26, comprising a condenser (50) to separate at least one constituent, in particular water from the first entraining gas (4), said condenser (50) being positioned in the first circuit (2) downstream of the reactor (8).~~

~~28~~19. Device according to any of Claims ~~19~~ 14 to ~~27~~18, wherein the first circuit ~~(2)~~ comprises a recycling passage ~~(90)~~ for recycling at least a portion of the first entraining gas ~~(4)~~ from a position downstream from the pre-heating section ~~(32)~~ or the condenser ~~(50)~~ to a position upstream of the reactor ~~(8)~~.

~~29~~20. Device according to any of Claims ~~19~~ 14 to ~~28~~19, wherein the second circuit ~~(12)~~ comprises a heat-recovery element ~~(60)~~, preferably said heat-recovery element being configured to exchange the heat accumulated in the second entraining gas ~~(14)~~ to the first entraining gas ~~(4)~~ at a section of the first circuit ~~(2)~~, more preferably said heat-recovery system ~~(60)~~ being a heat exchanger ~~(60)~~ positioned between the first ~~(2)~~ circuit and the second ~~(12)~~ circuit.

~~**30.** Device according to any of Claims 19 to 29, wherein the reactor (8) comprises at least one of the following elements: electric heater, oxy-burner, an indirect calciner such as solid heat-carrier reactor, an externally-fired calciner (84), or electrically-heated calciner, or a combination thereof.~~

~~**31.** Device according to any of Claims 19 to 30, wherein the reactor (8) comprises a fluidized bed reactor, an entraining bed reactor, a circulated fluidized bed or any combination thereof.~~

~~**32.** Device according to any of Claims 19 to 31, wherein the externally-fired calciner (84) comprises an intake passage (110), said passage (110) being connected to the second circuit (12), preferably downstream from the heating section (32).~~