Screening CO_2 capture test for cement plants using a lab scale Calcium Looping pilot facility.

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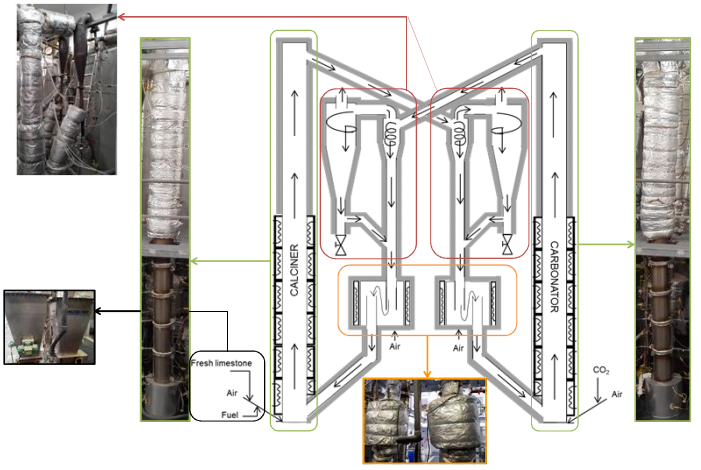
Objective

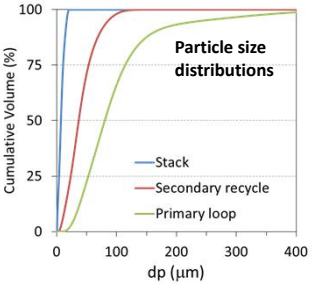
Calcium Looping (CaL) is based on the use of CaO as a regenerable sorbent of CO_2. The technology has been demonstrated for post-combustion CO_2 capture in power generation at TRL 6-7, but requires detailed testing at closer conditions to those expected in cement applications: higher CO_2 concentrations, higher sorbent activity and lower average particle sizes. We investigate these new operating conditions in a 30 kW_{th} CaL pilot in CEMCAP.

THE 30 kW TEST FACILITY

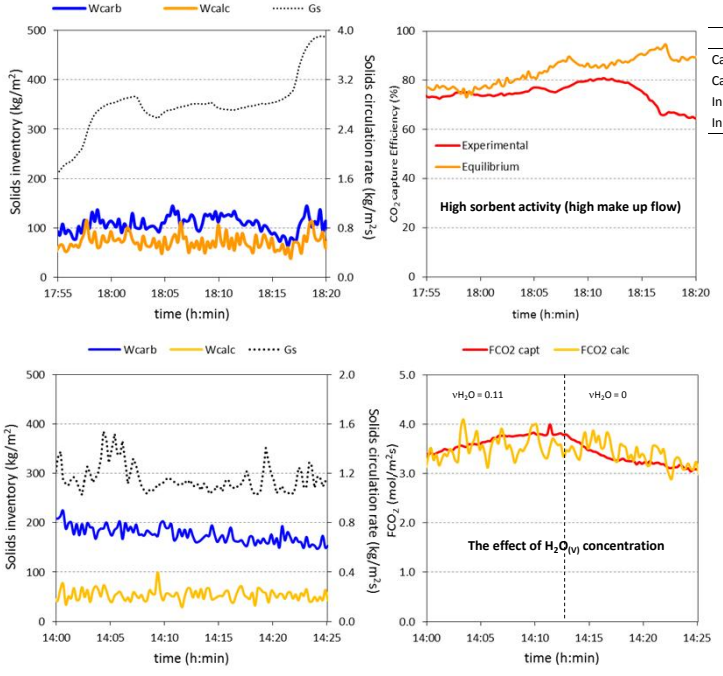


MAIN FEATURES

- Two CFB reactors (h = 6 m, d_t = 0.1 m)
- Double recycle loop
- Gas mixtures of CO_2, air, SO_2, H_2O feeds
- 40 Thermocouples, 20 ΔP measurements
- 4 O_2 zirconia probes,
- 2 on-line gas analysers (CO_2, O_2, SO_2, NO_x)



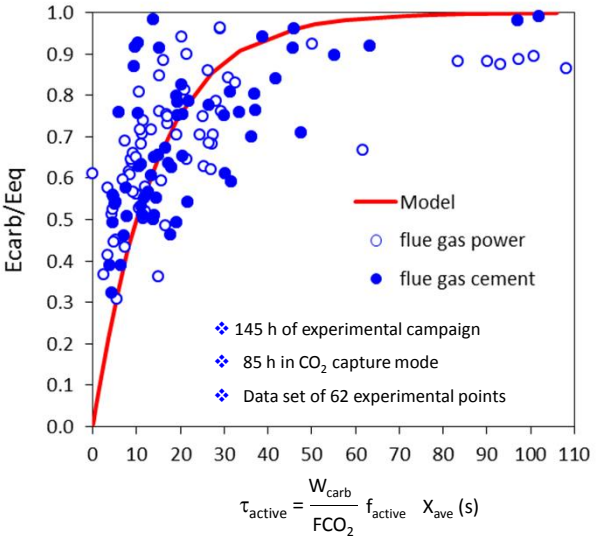
EXAMPLES OF EXPERIMENTAL RESULTS OF CO_2 CAPTURE



REACTION MASS BALANCE

RANGE OF OPERATING CONDITIONS

CARBONATOR			CALCINER		
Carbonator temperature (ºC)	T_{carb}	620-725	Calciner temperature (ºC)	T_{calc}	760-920
Carbonator inlet velocity (m/s)	u_{carb}	2-3.7	Calciner inlet velocity (m/s)	u_{calc}	1.5-3.3
Inlet CO_2 concentration (vol/vol)	vCO_2	0.1-0.27	Molar ratio fresh make-up to CO_2	$F0/FCO_2$	0-0.55
Inlet H_2O concentration (vol/vol)	vH_2O	0-0.12	Solids circulation flowrate (kg/m²s)	Gs	0.9-3.7



$$\tau_{active} = \frac{W_{carb}}{FCO_2} f_{active} \quad X_{ave}\ (s)$$

CONCLUSIONS

- High activity material resulting from large make up flows of limestone allow for high CO_2 capture efficiencies despite very low solids inventory in the reactor (100 kg/m²).
- Pilot plant and its reactor model behaves with similarly with flue gases from cement than with flue gases from power when using limestone as make up.

References

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