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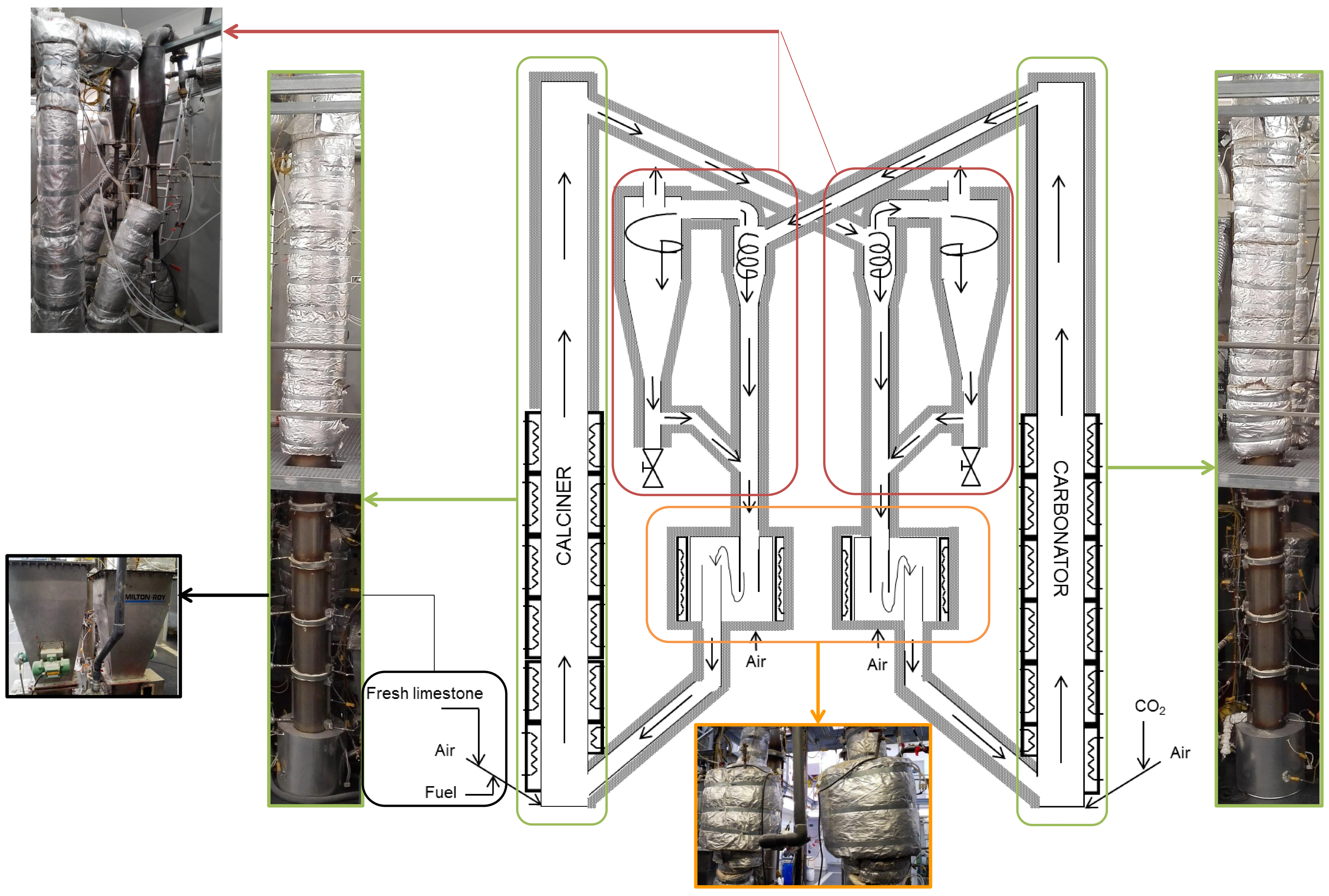
# Screening $CO_2$ capture test for cement plants using a lab scale Calcium Looping pilot facility.

M. Alonso, B. Arias, A. Méndez, F. Fuentes, J.C. Abanades
CSIC-INCAR, Francisco Pintado Fe, 26, 33011 Oviedo (Spain)

## Objective

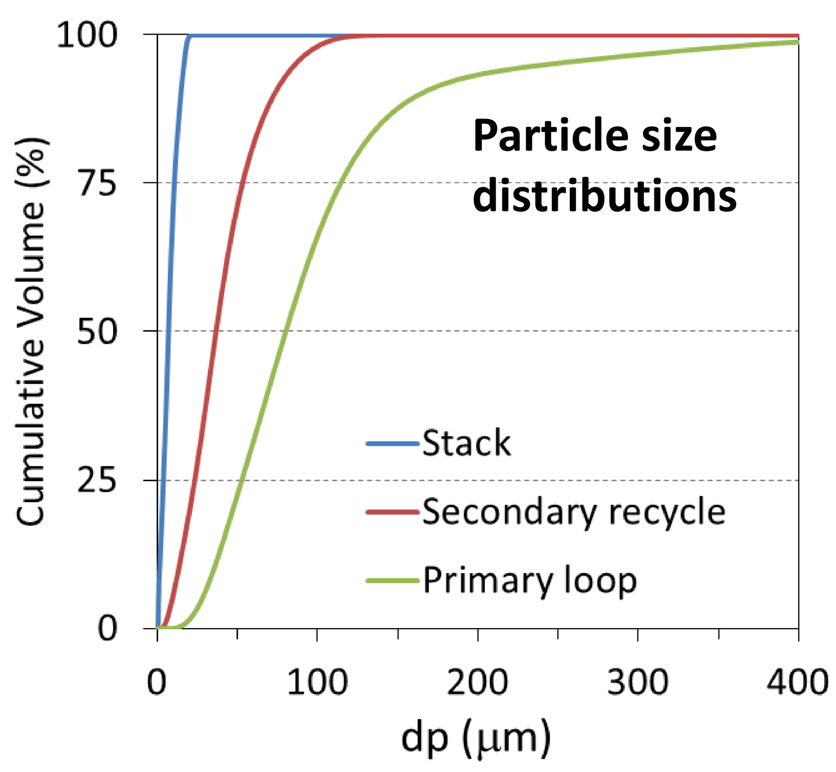
Calcium Looping (CaL) is based on the use of CaO as a regenerable sorbent of $CO_2$. The technology has been demonstrated for post-combustion $CO_2$ capture in power generation at TRL 6-7, but requires detailed testing at closer conditions to those expected in cement applications: higher $CO_2$ concentrations, 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

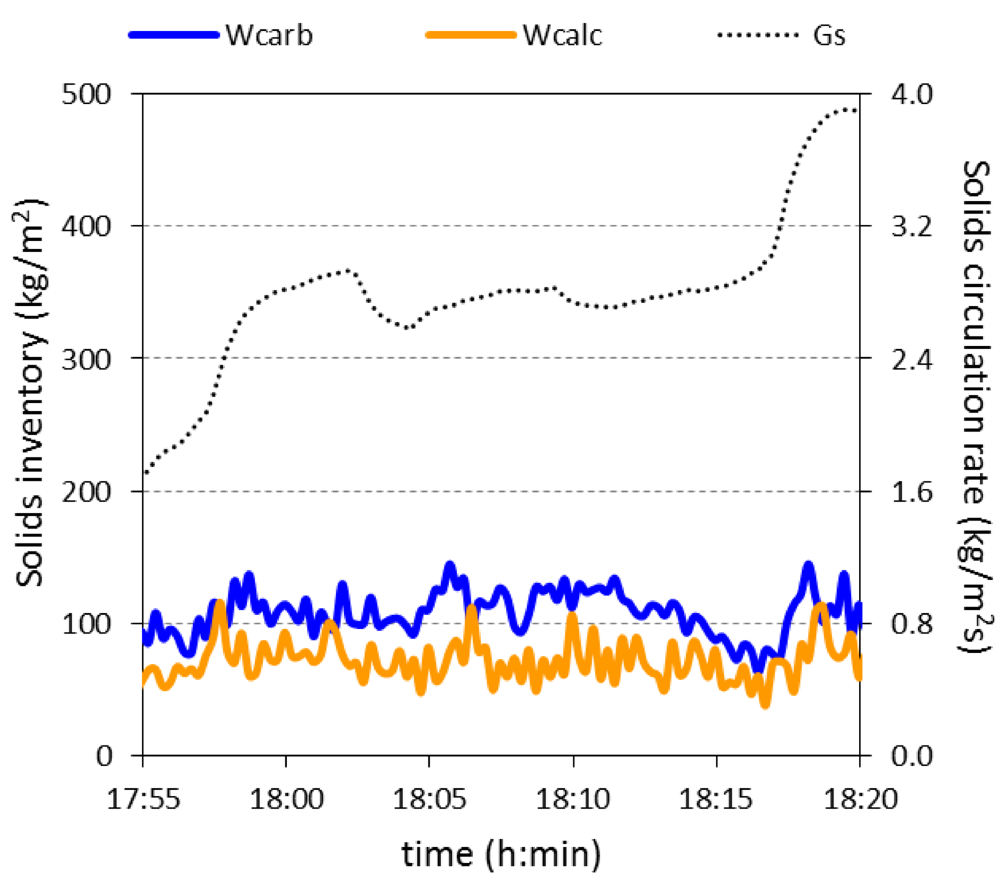


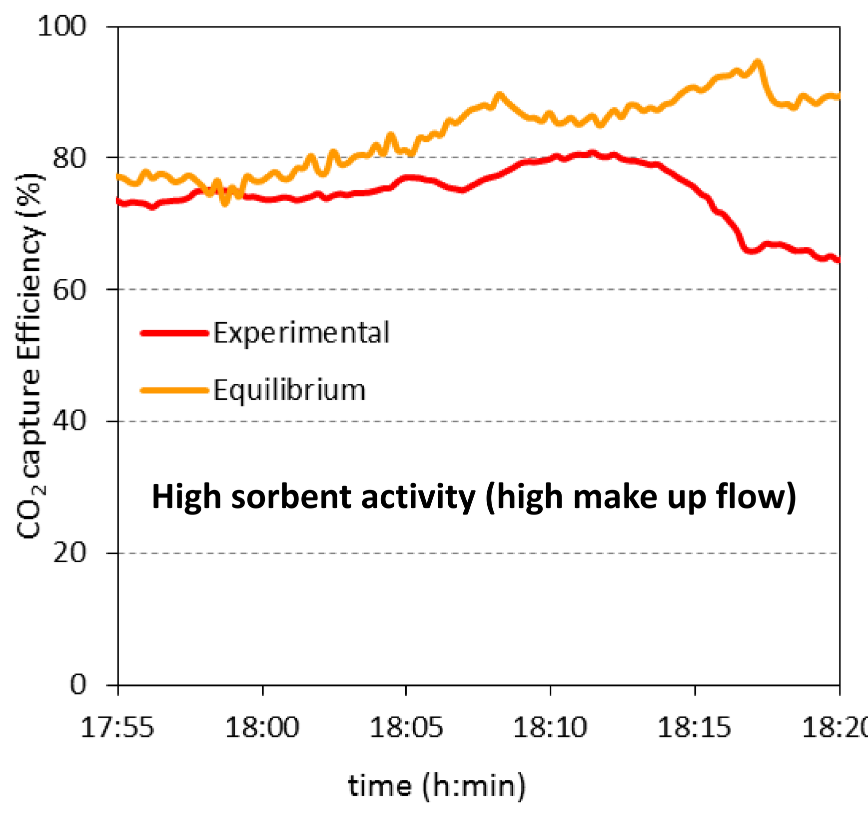

### MAIN FEATURES

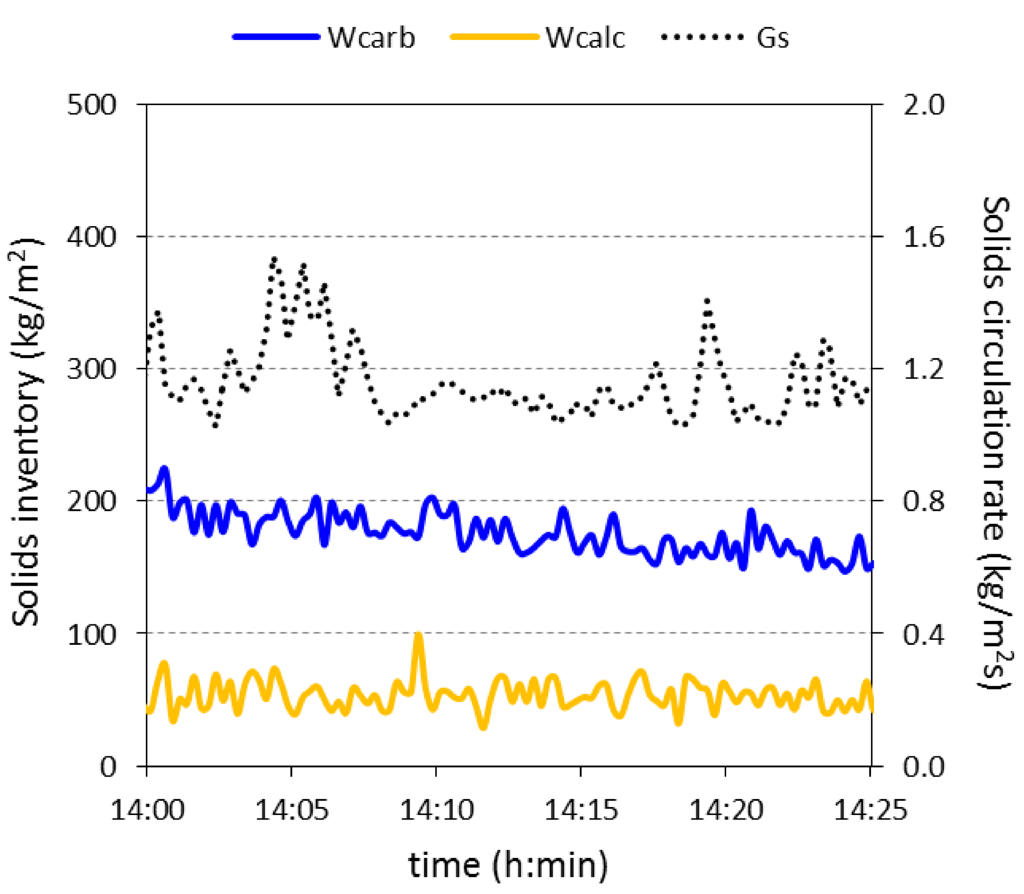
- Two CFB reactors (h = 6 m, $d_i$ = 0.1 m)
- Double recycle loop
- Gas mixtures of $CO_2$, air, $SO_2$, $H_2O$ feeds
- 40 Thermocouples, 20 $\Delta$P measurements
- 4 $O_2$ zirconia probes,
- 2 on-line gas analysers ($CO_2$, $O_2$, $SO_2$, $NO_x$)

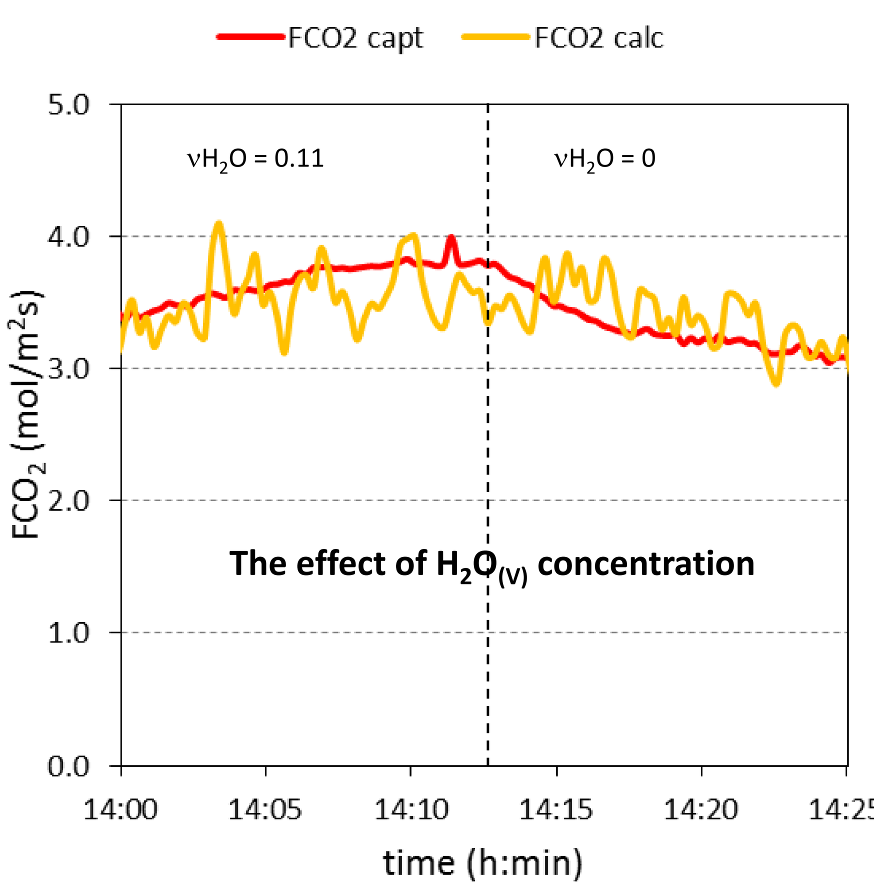



## EXAMPLES OF EXPERIMENTAL RESULTS OF $CO_2$ CAPTURE



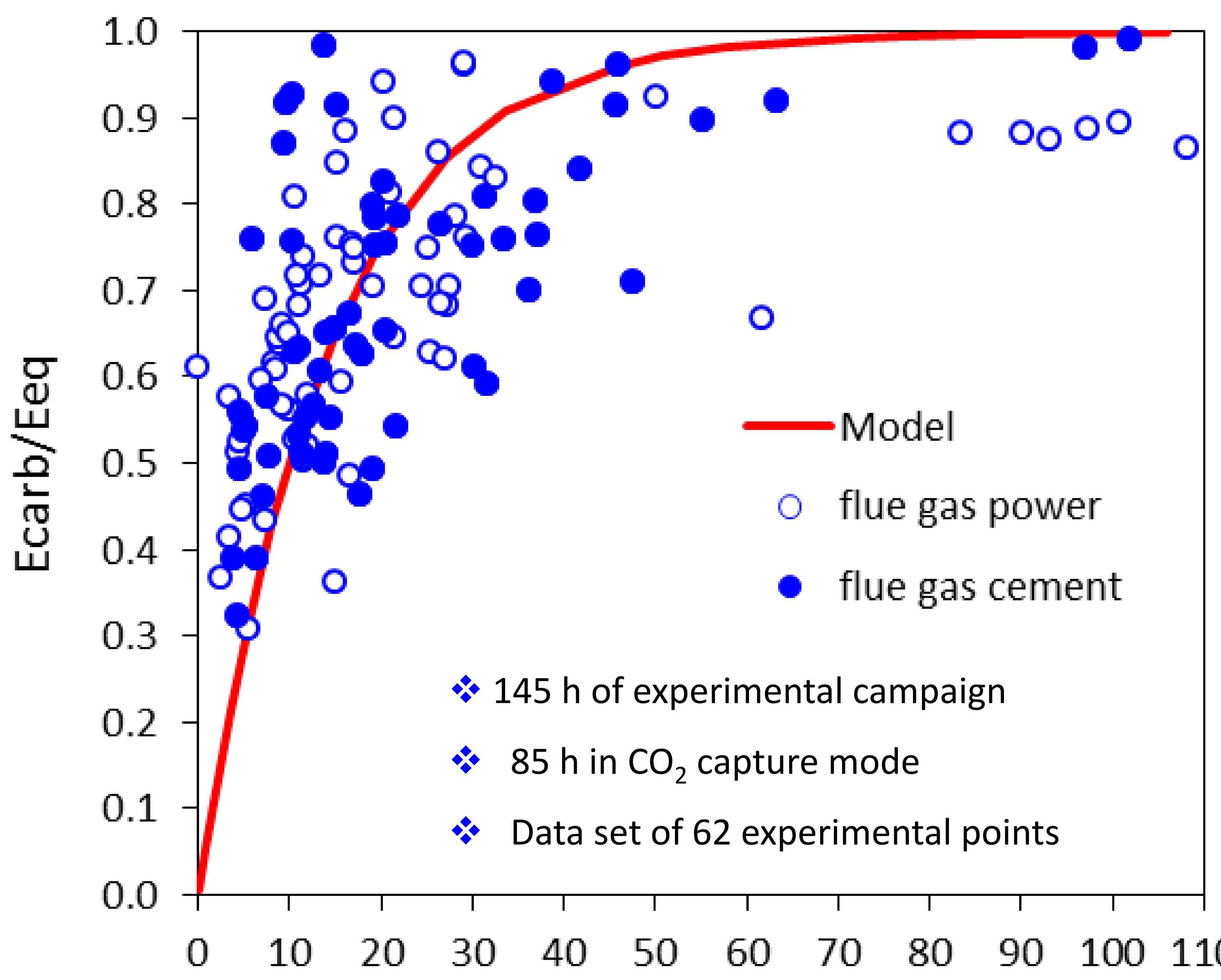




## REACTION MASS BALANCE

### 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) | $\nu CO_2$ | 0.1-0.27 | Molar ratio fresh make-up to $CO_2$ | $F0/FCO_2$ | 0-0.55 |
| Inlet $H_2O$ concentration (vol/vol) | $\nu H_2O$ | 0-0.12 | Solids circulation flowrate (kg/m²s) | Gs | 0.9-3.7 |




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

## 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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