UK Demonstration of Enhanced Calcium Looping and first Global Demonstration of Advanced Doping Techniques

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Project Overview

- Calcium (carbonate) looping is a promising technology for carbon capture
- Demonstrated at the MWth scale for successful demonstration of CO_2 capture from the exhaust of a large-scale power plant.
- CO_2 is captured as $CaCO_3$ from the exhaust of a power station, and then calcined to release a pure stream of CO_2.
- Here the exothermic CO_2 capture stage takes place around 650°C and the heat released in the carbonation process can be used in a standard steam cycle.

The basic concept

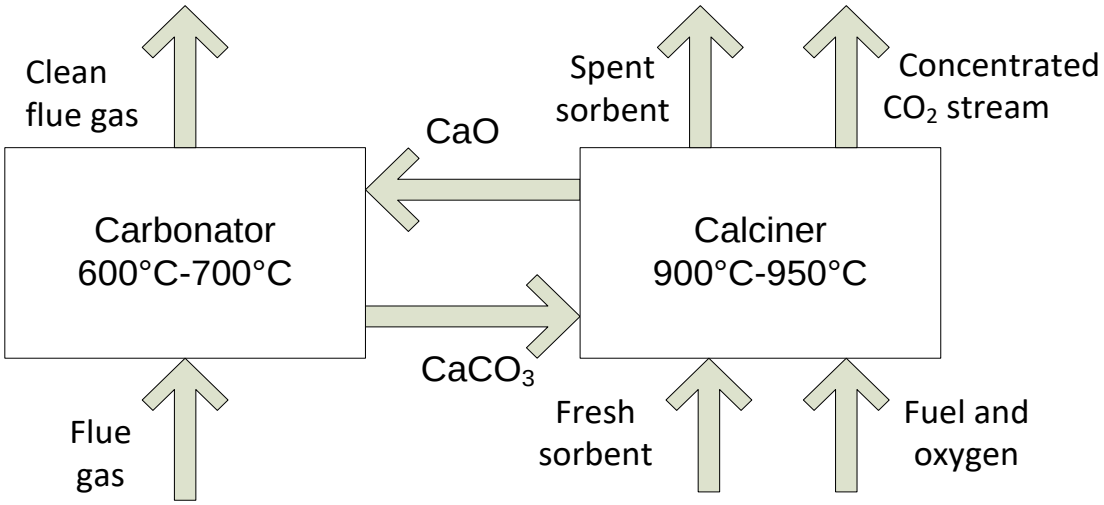


Fig. 1: Schematic of the calcium looping cycle

The Aims of this Project are:

- To demonstrate the viability of enhanced calcium looping technologies for CCS with the use of pelletized spent lime stream.

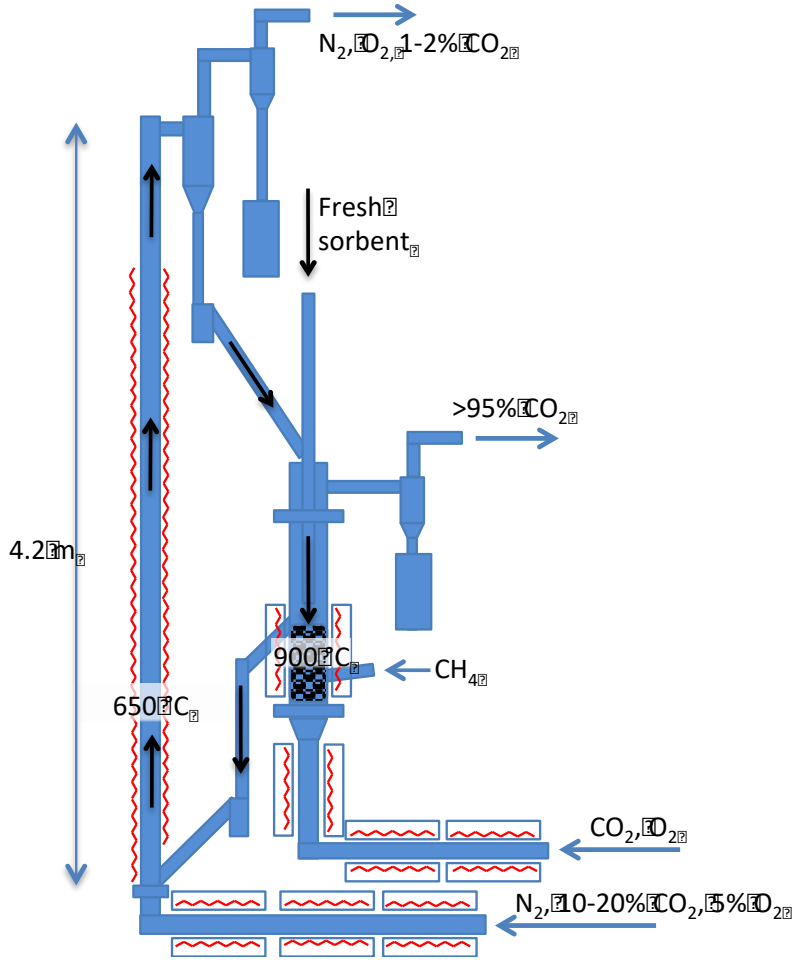
- To demonstrate the viability of calcium looping for the removal of CO_2 from industrial gases (steel and iron industry and cement industry).

- To explore the use of techniques to improve sorbent performance

Research Outputs

- An experiment was carried out on the 50 kWth dual-CFB facility at Cranfield.
- In total 12 kg of limestone was fed into the system during a 6-h long test.
- While the results were successful it was decided that this unit lacked flexibility, and it was decided to redesign a 25 kWth
- This unit was also able to simulate in pilot conditions the CO_2 removal from various industrial gases.

Project involved redesigning a 25 kWth Pilot Plant



Research Outcomes

- HBr-doping technique was modified in order to treat higher quantity of materials (of the order of 10 kg).
- This involved developing new techniques to treat the much larger amounts of materials

Research Outcomes

- Several experimental campaigns have been carried out with limestone and HBr doped limestone,
- These demonstrated the advantages of HBr doping when compared to untreated limestone
- Results showed a higher capture efficiency; and
- More surprisingly a lower attrition tendency of the sorbent.

Research Outcomes

- Different industrial gases have been tested proving the calcium looping concept in different industrial sectors
- Flue gases of up to 40% vol CO_2 were tested in different campaigns

Research Outcomes

- So far, 17 scientific papers have been published based on this work.
- These help broadens the general understanding of calcium looping and carbon-capture technologies.
- Ca looping is shown not only to be more efficient than any other back-end capture technology, but able to decarbonize the cement industry.

Research Outcomes

- The viability of using spent lime stream for cement manufacture was proven.
- Cements produced from kg level quantities of bed material performed as well “equivalently” to normal cement.