A TWIN-BED TEST REACTOR FOR CHARACTERIZATION OF CALCIUM LOOPING SORBENTS

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The reduction of sorbent CO2 capture capacity and the extent of particle attrition over iterated cycles are relevant to design of Calcium Looping processes (1-2). Thermogravimetric analyzers or fluidized bed reactors are generally used to evaluate the sorbent performance. One drawback of these reactors is that they do not reproduce the thermal history that is actually experienced by sorbent particles in real looping cycles. In this study, a novel experimental technique is proposed to overcome this limitation. The apparatus consists of two interconnected fluidized bed reactors operating as calciner and carbonator, respectively (Fig. 1). The two reactors are connected each other by a duct (whose openings can be located at adjustable level above the gas distributor) which permits pneumatic transport of the solids between the reactors. Silica sand is used as buffering inert material to prevent excessive temperature fluctuations due to solid transport and chemical reactions. The operating conditions (fluidization velocity and duct height) of the reactor have been tuned to maximize transfer of the sorbent at each cycle, while limiting the transport of sand (Fig. 2). Further tests were carried out to simulate multiple calcination/carbonation cycles (Fig. 3). Under the optimal experimental conditions more than 95% collection efficiency of the limestone was obtained while less than half of the sand was transferred. Additional tests were carried out at high temperature but under non-reacting conditions, so as to simulate the real thermal history of the particles.

REFERENCES
Figure 1. Twin beds apparatus and scheme of the solid transport procedure between the two fluidized bed reactors.

Figure 2. Limestone transport efficiency ($\eta$) – left – and mass of transported sand – right – as a function of the gas superficial velocity and of the level $h_B$ of the suction duct.

Figure 3. Limestone transport efficiency ($\eta$) – left – and mass of transported sand – right – as a function of the number of cycles for multicycle tests with the twin beds.