

Ca-Looping for Thermochemical Energy Storage

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Ca-Looping process has aroused interest as a high temperature thermochemical energy storage (TCES) system [1]. The process consists of the reversible reaction between CaO and CaCO₃. Within the framework of the H2020 European project SOCRATCES [2], a novel pilot plant has been built in Seville with the aim to demonstrate the viability of the integration of the Ca-Looping process in concentrated solar power to store solar energy (CSP). The plant is composed of two separate reactors: one for calcination in the air atmosphere at high temperatures (~1000°C) and a carbonator that operates in CO₂ at 800°C. The facility involves 12 heliostats which heat the reactor to drive the endothermic decomposition of CaCO₃. Once the calcination reaction is complete, the resulting CaO is translated by means of a pneumatic system to the carbonator reactor where it is placed in contact with a CO₂ atmosphere to induce the reverse exothermic reaction and produce energy on-demand.

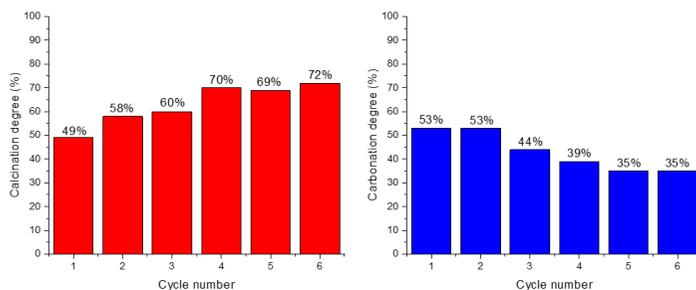


Figure 1: Calcination and carbonation evolution with the cycle number for tests done in the pilot plant

Here, we discuss the feasibility of the process considering the preliminary results obtained from the tests carried out in the plant. An overview of the procedure shows an evolution of the process requirements. Figure 1 illustrates the conversion attained during several cycles. As it may be seen, the calcination degree achieved is over 70%. On the

other hand, carbonation results show a decay in the performance related to the deactivation of the CaO. These results are encouraging about the feasibility of the scale-up. As the plant is operating and there is still a learning curve about processes and operation conditions, a series of adjustments will be made to improve calcination/carbonation cycles and generate additional information. Therefore, there is a positive trend towards as the system is adjusted and experience and knowledge in the technology are gained.

References

- [1] C. Ortiz, J. M. Valverde, R. Chacartegui, L. A. Perez-Maqueda, and P. Giménez, "The Calcium-Looping (CaCO₃/CaO) process for thermochemical energy storage in Concentrating Solar Power plants." *Renew. Sustain. Energy Rev.*, vol. 113, no. July, p. 109252, 2019, doi: 10.1016/j.rser.2019.109252.
- [2] "Socratces Project | Energy Storage Technologies Viable & Sustainable." <https://socratces.eu/> (accessed Nov. 10, 2021).