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Development of CaO-based Sorbents Applied to Sorption Enhanced Steam Reforming Processes

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Abstract : In situ CO_2 capture in steam reforming processes has been studied in the last years as an alternative for increasing H_2 yields and H_2 purity in the product stream. For capturing the CO_2 at the reforming conditions, CaO-based sorbents are usually employed due to their properties at high temperature, low cost and high availability. However, the challenge is to develop high-capacity (gCO_2/gsorbent) materials that retain their capacity over cycles of operation. Besides, since the objective is to capture the CO_2 generated in situ, another key aspect is the sorption dynamics, which means that, in order to efficiently use the sorbent, it has to capture the CO_2 at a rate equal to or higher than the generation rate. In this work, different CaO-based materials have been prepared to aim at meeting these criteria. First, and by using the wet mixing method, different inert materials (Mg, Ce and Al) were combined with CaO. Second, and with the inert material selected (Mg), the effect of its concentration in the final material was studied. Transversally, the calcination temperature was also evaluated. It was determined that the wet mixing method is a simple procedure suitable for the preparation of CaO sorbents mixed with inert materials. The materials prepared by mixing the CaO with Mg have shown satisfactory anti-sintering properties and adequate sorption kinetics for their application in steam reforming processes. Regarding the concentration of Mg in the solid, it was concluded that high values contribute to the stability but at the expense of losing sorption capacity. Finally, it was observed that high calcination temperatures negatively affected the sorption properties of the final materials due to the decrease in the pore volume and the specific surface area.

Keywords : calcination temperature effect, CO_2 capture, Mg-Ce-Al stabilizers, Mg varying concentration effect, Sorbent stabilization
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