Abstract

Greenhouse effects caused by the daily increase of CO_2 are becoming more serious recently. The emerging hybrid technology – CO_2 capture & mineral carbonation – provides a novel and effective route in Carbon Capture, Utilization & Storage (CCUS). In this way, CO_2 not only can be absorbed, also can be utilized to produce carbonate product. However, there is a lack of systematic investigation on the amine selection in this hybrid technology. The product properties such as crystal morphology and transformation are not systematically reported. In this work, four amine categories have been selected: primary amine (ethanolamine, MEA), secondary amine (diisopropanolamine, DIPA), tertiary amine (diethylethanolamine, DEAE) and triamine (diethylenetriamine, DETA). Different temperatures and amine concentrations have been studied to comprehensively discuss the carbonation process and product properties. DETA exhibited the highest absorption rate and largest equilibrium CO_2 loading (1.4:1 mol CO_2 / mol amine). DEAE had a ratio of 1:1; while MEA and DIPA performed a similar absorption rate and loading (0.5:1). The carbonation of all amines was enhanced with the increase of temperature except for DEAE. When the amine concentration increased, MEA, DIPA and DETA were limited in the carbonation process, while DEAE showed the fastest carbonation (nearly 100% Ca conversion) with all the investigated concentrations. As regards to crystal transformation, all the formed vaterite partially or totally transformed to calcite over time, except in the case of DETA. Hence, tertiary amines (i.e. DEAE) have a huge potential to enlarge this hybrid technology in the industry.