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Portland Cement (KS and API Class G) and Relative Quantitative Analysis

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Portland cement is a common component consisting of a sealing material for wellbores for geological carbon storage to prevent vertical fluid migration and provide mechanical support. Portland cement was reacted with carbon dioxide (CO_2) in supercritical, gaseous, and aqueous phases at various pressure and temperature conditions to simulate a cement-CO_2 reaction along the wellbore from the carbon injection depth to the near surface. The reaction of the cement phase with CO_2 can lead to important changes in its structure and properties. In this study, two types of cement were used: KS Portland cement and API Class G Portland cement. The hydrated cement sample columns (14 mm diameter X 90 mm long; water-to-cement ratio = 0.5) were reacted with CO_2 in the saturated and the unsaturated condition. Fly-ash was used as additives to promote carbonation. These conditions were maintained under high pressure (8 MPa) and temperature (40 degree Celsius) for 10 and 100 days. To analyze the degree of carbonation after cement carbonation, relative quantitative analysis was proposed. And Rietveld method were conducted to evaluate a relative quantitative analysis (RQA) with an aragonite-calcite equation. This method can be an alternative to the general quantitative analysis method to identify the state of cement carbonation between Portland cement and CO_2. Based on an understanding of cement carbonation and its relative quantification, we propose that our method should be used to select the optimized cement for CO_2 storage. Using our method, KS (Korea Standard) Portland cement (type I) and API Class G Portland cement have been compared with respect to the characterization of each cement and to the cement carbonation of each cement.