IN SITU TIME-RESOLVED X-RAY DIFFRACTION OF TOBERMORITE FORMATION PROCESS UNDER HYDROTHERMAL CONDITION: INFLUENCE OF REACTIVE AI COMPOUND

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Autoclaved aerated concrete (AAC) is widely used as a building material because of its superior heat-insulation efficiency and fire resistance. A typical process for the AAC production includes hydrothermal treatment of a mixture of quartz sand, lime, cement, gypsum at high temperatures under a saturated steam pressure, which results in the formation of crystalline calcium silicate hydrates, namely, tobermorite (5CaO·6SiO2·5H2O). Although understanding the mechanism of tobermorite formation during the hydrothermal treatment is very important to improve physical properties of AAC, it is difficult to monitor the reaction in situ owing to the high temperature and high steam pressure of the reaction conditions. We have developed an autoclave cell for transmission XRD, and the formation reaction of tobermorite has been successfully studied [1]. In the present study, the influence of γ-Al2O3 in the starting material was investigated.

In situ XRD measurements were carried out at the BL19B2 beamline of SPring-8, using an X-ray energy of 30 keV. The cell temperature was elevated from 100 to 190 °C at a ramping rate of 1 °C/min, and then held at 190 °C for 12 h. During this process, the XRD measurements were conducted under a saturated steam pressure using a photon-counting pixel array detector, PILATUS 100K (DECTRIS).

Figure 1 shows time dependence of peak intensities for the major constituents for a sample with γ-Al2O3. Decrease of quartz and Ca(OH)2 followed by increase of tobermorite (T) was clearly observed. Al-containing intermediate material, katoite (KA: Ca3Al2(SiO4)(OH)8) was observed as well. The role of KA with respect to tobermorite formation will be discussed.