Reduction of selenate in ettringite by calcination

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The property of ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$) has been well investigated because of its ion-exchange ability. Heat treatment is widely applied to treat the hazardous materials to reduce their volume. Understanding the properties of hazardous anionic species, especially anionic radionuclides including $^{79}SeO_3^{2-}$ and $^{79}SeO_4^{2-}$, which are incorporated in ettringite, is a practical issue in hazardous wastes treatment. In the present work, the thermal stability of SeO_4^{2-} bearing ettringite was investigated because the thermal behavior of ettringite under high temperature is still unclear. SeO_4^{2-} bearing ettringite was gradually transformed into a new crystal phase until 600 °C. In addition, the incorporated SeO_4^{2-} was gradually reduced to SeO_3^{2-} after calcination around 800 ° C and the coordination of Se oxoanions was also converted from outer-sphere to inner-sphere. Based on the results of extended X-ray adsorption fine structure (EXAFS) and ^{27}Al nuclear magnetic resonance (^{27}Al-NMR), the partial structure of the new phase was proposed. Finally, it is proved that the reduction was caused by the dehydroxylation, providing electron donor sites on the ettringite. Furthermore, calcination of SeO_4^{2-} bearing ettringite at 800 °C much improved the stability of selenium.

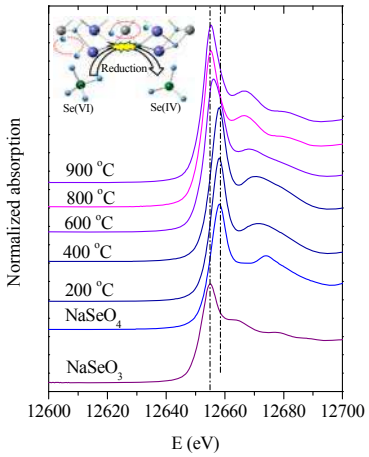

Fig. 1: Se K-edge XANES spectra of calcinated selenate ettringite under various temperatures.