Development of solidification techniques with minimised water content for secondary radioactive aqueous wastes in Fukushima
(3) Heat-treatment of phosphate modified calcium aluminate cement under open system

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The present study investigates the effect of water loss during the curing of phosphate-modified CAC system at different temperatures (35ºC, 60ºC, 90ºC, 180ºC) in open systems. Experimental results indicate that these phosphate-based cements do not form the conventional CAC crystalline hydration products at these temperatures but provide structural integrity despite a significant amount of water loss. Hydroxyapatite was detected at temperatures ≥60ºC.

Keywords: Calcium Aluminate Cement (CAC), Phosphates, C-A-P-H gel, hydroxyapatite

1. Introduction

The addition of phosphates to calcium aluminate cements have been shown an effective way to avoid the ordinary conventional hydration of cementitious systems. These systems set and hardened via acid-based reaction, between the acid phosphates solution and the basic CAC cement [1,2]. Due to this different mechanism of reaction, it would be possible to generate a compact cementitious product with a reduced water content, which can be beneficial to avoid hydrogen gas generation associated with the radiolysis of water by radioactive wastes. The present study investigates the effect of heat treatment (at different temperatures) of phosphates modified CAC cements in open systems.

2. Experimental

Phosphate modified CAC pastes were prepared with a water/cement ratio of 0.35, a polyphosphate cement ratio of 0.4 and a monophosphate/cement ratio of 0.05. CAC pastes with same water content were used as a reference. Samples were kept at different temperatures (35ºC, 60 ºC, 90 ºC, 180ºC) in open systems for 28 days. During this time the loss of water was monitored. After 28 days samples were characterized by XRD, TG, MIP and SEM.

3. Results and discussion

Phosphate-based cements did not form the conventional CAC crystalline hydration products but provided structural integrity, with a slightly decreased porosity compared with the unmodified CAC. While CAC systems have a limitation in the reduction of water, it can be reduced in a larger extent in phosphate modified CAC. Hydroxyapatite was the only crystalline hydrated product detected when we work at temperatures ≥ 60 ºC. The results are further discussed in relation to the hydrate phases in these two systems.

References

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