THE POTENTIALS OF GEOPOLYMER FOR RAPID-SET HIGH-STRENGTH CEMENT IN CONCRETE REPAIR

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Abstract

The repair of many concrete structures like busy roads, aircraft runways, water tank etc, requires cement that sets fast and gains its strength quickly. There are cements that meet these requirements such as calcium sulfoaluminate-based cements, magnesium phosphate cements, calcium fluoroaluminate etc, however these cements are expensive. On the other hand, cement additives or accelerators have been used to accelerate hardening of ordinary Portland cement. The accelerators include compounds of chloride, nitrates, formates and nitrates. However, the use of chlorides is not recommended for reinforced concretes because chloride ions will induce pitting corrosion to the reinforced steels.

Geopolymer cement, often referred to as alkali cement, is synthesized from precursors with high content of silica (SiO₂) and alumina (Al₂O₃) activated by alkaline activator. Geopolymer has the potentials for rapid-set high-strength cements because, unlike Portland cement which hardens via exothermal hydration, the hardening or curing of geopolymer is a polycondensation process. Experiments in our laboratory showed that geopolymer concretes achieved the strength of 28-day ordinary Portland cement concretes in 3 days after curing for 24 hours at −60°C. Previous experiments also showed that setting or curing time is controlled by temperature and composition of the geopolymer mixtures. The behaviour of setting and curing of geopolymers will be intensively studied in one of our research activities in 2009.

Keywords: geopolymer, rapid-set high-strength cement, alkali-cement.

1. INTRODUCTION

The repair of many concrete structures like busy roads, aircraft runways, water tank etc, requires cement that sets fast and gains its strength quickly. There are cements that meet these requirements such as calcium sulfoaluminate-based cements, magnesium phosphate cements [1], calcium fluoroaluminate with calcium sulphate or ordinary Portland cements etc, however these cements are expensive. On the other hand, cement additives or accelerators have been used to accelerate hardening of ordinary Portland cement. The accelerators include compounds of chloride, nitrates, formates and nitrates. Two kinds of chloride compounds: calcium chloride and sodium chloride are commonly used as accelerators. However the addition of these chloride compounds is not recommended for prestressed and reinforced concrete because chloride ions will induce pitting corrosion to the reinforced steels. Besides, the addition of calcium chloride will reduce concrete resistance to sulphates [2]. Other accelerators which are not corrosives like nitrates, formates and nitrates are more expensive and less effective in their accelerating ability.

Geopolymer is a potential candidate for use as rapid-setting cements because geopolymer hardens via polycondensation process. Due to this mechanism,