COMPOSITE BINDERS OF URBAN WASTE GLASS-METAKAOLIN CHEMICALLY ACTIVATED, EFFECT OF THE TYPE OF ALKALINE AGENT

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ABSTRACT

This work studied the effect of different alkaline agents on the alkaline activation of composite pastes of Urban waste glass (UWG) and metakaolin (MK). Sodium silicate of various modulus (Ms) and mixtures of NaOH:Na2CO3 were used at various concentrations of equivalent %Na2O. An experimental design was carried out using the Taguchi method. The compressive strength (CS) was followed for up to 120 days; characterization by X-ray diffraction and scanning electron microscopy were also carried out. The results showed that the strength depends on the experimental conditions of, %Na2O and Ms and showed values above 50 MPa after 120 days for pastes with 33%WG-67%MK; while a Portland cement specimen cured at 20°C reached 43 MPa. The WG is more reactive than the MK under less alkaline conditions. The microstructures varied notably with the type of activator; however, all showed relative dense matrices of reaction products, in agreement with the strength noted.

Keywords: Urban Waste Glass, Metakaolin, Activated cements, Composite Binders.

INTRODUCTION

Synthetic pozzolanas and other waste materials used as partial or total replacement of portland cement (PC) favours: the reductions of global pollution and of the demand of PC, the utilization of waste materials (Roskovic, D. Bjegovic, 2005) and in general the sustainable development. Studies of alkali activated binders date from the last century (Purdon, 1940). Geopolymers and alkali activated cements are commonly obtained the reaction of alkaline solutions activating and dissolving the silica and alumina from the glassy structure of the raw materials (Mackenzie 2003; Zhang et al 2004). Waste glass on alternative binders has 3 routes (Shi and Zheng, 2007): as aggregate for concrete, raw materials (SiO2 source) and as a partial replacement for PC (Shia et al, 2005). The replacement of PC by waste glass, modifies its hydration; however, the use of UWG bears the risk of the alkali silica reaction (Taylor, 1997). This work investigated composites of non-Portland cement using the WG as a raw material to produce alkali activated binders in combination with MK.

RESULTS AND CONCLUSIONS

The compressive strength results (Fig. 1) show that in composites with higher MK contents, the use of sodium silicate was effective towards strength development; nonetheless, the use of mixtures of NaOH:Na2CO3 did not result in any significant strength gain for 120 days. In the other hand, for composites with high contents of urban waste glass, the sodium silicate was
still an effective activator. It was noteworthy that the use of mixtures of NaOH:Na$_2$CO$_3$ was effective under certain conditions, resulting in strengths above 40MPa. The study shows glass requires less alkaline conditions than metakaolin to develop strength, and that UWG can be used for composite alkali activated binders. X-ray diffraction showed the formation of reaction products different to those of the starting materials, which together with the microstructural analysis indicated the intensive reaction of the UWG and MK.

![Fig. 1 - Compressive Strength for various composites of Urban Waste Glass-Metakaolin activated with various alkaline agents](Image)

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REFERENCES