

Effects of type and dosage of alkaline activator and temperature on the properties of alkali-activated slag mixtures

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Abstract

In this paper the results of a study on the influence of sodium hydroxide, sodium carbonate, and sodium silicate, as activators, and temperatures in the range of 20–31 °C on the setting time and workability of the fresh alkali-activated slag cement (AAS) mixtures are presented. The results obtained show a significant acceleration of the setting of the AAS mixtures versus the setting of ordinary Portland cements. The highest acceleration of the setting was found with sodium silicate, while both sodium hydroxide and sodium carbonate show a moderate effect. The increase of temperature of the mixtures shows the acceleration of setting and decrease of workability. At the sodium silicate a continuous effect was observed as temperature was increased. But with sodium hydroxide and sodium carbonate a sudden acceleration of the setting, and workability decrease were observed, when the temperature reached the values 24–29 °C.

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1. Introduction

The goal of sustainable development of the cement and concrete industry is very important, and can be reached if the cementitious and pozzolanic by-products from thermal power plants and metallurgical industries are used. Finely ground granulated blast furnace slag (GrBFS) has been used as an important ingredient of a supplementary binder with ordinary Portland cement (OPC). Since GrBFS itself is nothing more than latent hydraulic binder, it must be activated to react and provide the desirable mechanical properties. Alkali components for the activation of the slag–alkaline cements may be the components like caustic alkalis, nonsilicate salts of weak acid, silicate salts and aluminates [1,2]. Increasingly attention has been paid in the last years on alkali–slag (AAS) cements. However, due to the numerous influencing factors, such as the chemical and mineral composition of the slag, the amount of glassy

phase as well as the type and concentration of activator used, alkali activation of slag is still an insufficiently defined process requiring further research [3]. The importance of such research is expressed by the fact that engineering properties of concretes based on alkali–slag cements are significantly dependent on the process of the activation.

High strength and durability of concretes based on AAS cements are reported [4,5]. Mechanical properties, as well as other properties of the hardened material, are determined by the nature of the compounds forming during the activation and curing process. It is reported that compressive strength of a hardened material can be high as 100 MPa. But quick setting problems are known. Even the possibility of varied setting times between batches and from mix to mix using one batch of the slag are also reported [6–9].

The use of retarding agents seems to be an effective way. Hundreds of chemical admixtures including water reducers, retarder, surface active agents and dispersants, effective in OPC cement mixtures, have been investigated for the

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- Plasticity using the Haegermann vibrating device and the estimation of the measure of the spreading S_p (cm) of the mortar mix (STN 72 2441 and STN 73 1312),

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