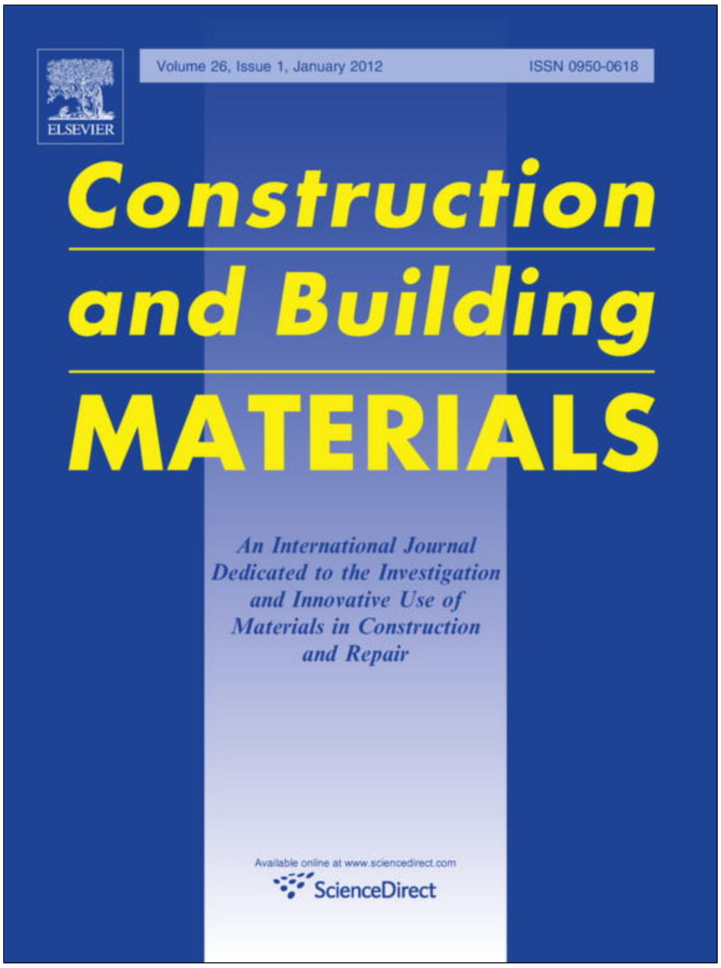
Provided for non-commercial research and education use.
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

http://www.elsevier.com/copyright

Author's personal copy

Construction and Building Materials 26 (2012) 310–316

Contents lists available at ScienceDirect

Construction and Building Materials

journal homepage: www.elsevier.com/locate/conbuildmat

Physico-chemical and mechanical characteristics of pozzolanic cement pastes and mortars hydrated at different curing temperatures

M.A. Abd-El.Aziz [a], S. Abd.El.Aleem [b], Mohamed Heikal [c,*]

[a] Faculty of Engineering, Fayoum University, Fayoum, Egypt
[b] Chemistry Department, Faculty of Science, Fayoum University, Fayoum, Egypt
[c] Chemistry Department, Faculty of Science, Benha University, Benha, Egypt

ARTICLE INFO

Article history:
Received 9 December 2010
Received in revised form 29 May 2011
Accepted 18 June 2011
Available online 19 July 2011

Keywords:
Physico-chemical and mechanical characteristics
Slag
Pozzolanic cement and curing temperature

ABSTRACT

The effect of elevated curing temperature on the properties of cement mortars is vital for heat resistance. Addition of pozzolanas, such as slag, to type I cement is known to increase heat resistance. In this study, OPC was partially substituted by two types of slag (WCS and ACS) in the ratios of 10, 20, 30, 40 and 50 wt.%. The cement mortars were cured for 120 days at different curing temperature from 25 to 100 °C. The results show that, elevated curing temperatures improves the early age strength in the all cement mortars. Also, the results indicated that, the pozzolanic cement mortars gives higher compressive strength than the plain cement mortars, especially at curing temperatures above 35 °C. Therefore, slag pozzolanic cement mortars can be beneficially used in the hot conditions.

© 2011 Elsevier Ltd. All rights reserved.

1. Introduction

Ground granulated blast-furnace slag is a by-product of the manufacturing of iron in a blast-furnace where iron ore, limestone and coke are heated up to 1500 °C. When these materials melt in the blast-furnace, two products are produced – molten iron, and molten slag. The molten slag is lighter and floats on the top of the molten iron. The molten slag comprises mostly silicates and alumina from the original iron ore, combined with some oxides from the limestone. The process of granulating the slag involves cooling the molten slag through high-pressure water jets. This rapidly quenches the slag and forms granular particles generally no larger that 5 mm in diameter. The rapid cooling prevents the formation of larger crystals, and the resulting granular material comprises some 95% non-crystalline calcium-aluminosilicates [1]. The granulated slag is further processed by drying and then ground to a very fine powder, which is WCS (ground granulated-blast furnace slag). Different forms of slag product are produced depending on the method used to cool the molten slag. These products include air-cooled blast-furnace slag (ACS), expanded or foamed slag, palletized slag, and granulated blast furnace slag. The chemical composition of slag can vary over a wide range depending on the nature of the ore, the composition of the limestone flux coke consumption and the type of iron being made [2]. The granulated slag has been used as a pozzolanic admixture in Portland cement [3]. The major components of slag are SiO_2, Al_2O_3, CaO and MgO which are common components in commercial silicate glasses.

Cement containing water-cooled slag (WCS) has long been used in Egypt. Alternatively, many other unexploited slag by-products, such as air-cooled blast furnace slag and steel-making slag are available. The feasibility of utilizing these types of slags has been ignored, due to the judgment that air-cooled slag (ACS) is hydraulically unreactive. Consequently, little of these materials are used, or their use is limited to low valuable applications. Although, the reactivity of ACS is lower than WCS at room temperature, it is still can be exploited as a hydraulic material. Even, if these slags still cannot fulfill the requirements of the standard specifications for blended cements, their hydraulic activities can be exploited in building materials, such as autoclaved building materials or bricks [4]. The latter may be an economical alternative for developing countries, since little technology is required. There are little researches based on the utilization of ACS in cements.

The electrical conductivity is a useful technique to study the change in the phase composition at different temperatures during the setting and hardening of calcium aluminate cement (CAC), the variations of electrical conductivity with the hydration time were measured at 20, 40 and 60 °C, as well as reflecting the role of ACS and WCS, preventing the conversion reaction occurring during the CAC hydration. Air-cooled slag (ACS) and water-cooled slag (WCS) restricted the conversion reactions by the preferential formation of C_2ASH_8 (stratlingite) compared to that of C_3AH_6 [5–7]. The compressive strength increases in the presence of slag WCS or ACS is due to the formation of stratlingite. Stratlingite is a stable crystalline phase in the temperature up to 70 °C [5]. In this system,

* Corresponding auther. Tel./fax: +20 133222578.
E-mail address: ayaheikal@hotmail.com (M. Heikal).

0950-0618/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.conbuildmat.2011.06.026