

UTILIZATION OF SOME INDUSTRIAL SOLID WASTES AS SLAG COAGULATORS IN THE SMELTING PROCESS AND IN THE PRODUCTION OF BLENDED CEMENT

By

Ezz El-Din Hassan Ramadan

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Master Science in Biochemistry, Ain Shams University, 1999**

**A Thesis Submitted in Partial Fulfillment
of the Requirement for the Doctor of Philosophy
in Environmental Science**

**Department of Biological & Natural Science
Institute of Environmental Studies & Research
Ain Shams University**

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استخدام بعض المخلفات الصناعية الصلبة كمواد مجمعة لخبث المسبوكات وإنتاج الأسمنت المخلوط

رسالة مقدمة من
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فني العلوم البيئية

قسم العلوم البيولوجية والطبيعية
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ABSTRACT

Granulated blast-furnace slag (GBFS) is an industrial solid waste produced during the production of pig iron industry. The present investigation represents the utilization of different proportions of granulated blast-furnace slag (GBFS) in the production of Portland blast-furnace slag cements mixed with ordinary Portland cement (OPC). In addition to, feldspar was selected to be a slag coagulator in the smelting process after mixing with granulated blast-furnace slag in different ratios. For these reasons various slag cement pastes are made of three mixes of OPC and GBFS, namely, with OPC/GBFS ratios of 70/30, 50/50 and 30/70; these mixes are designated as Mixes I, II and III, respectively, and their results were compared with those of OPC cement pastes. The slag cement pastes are prepared from each OPC-GBFS blend using different initial water/cement (W/C) ratios of 0.25, 0.35, 0.40 and 0.50 as well as the amount of water required for the standard water of consistency (the standard W/C ratio). All of the cement pastes are hydrated at 30 °C for various time intervals. In addition, the cement pastes made with the standard water of consistency are hydrated at 20, 30, 45 and 60 °C for different time intervals. Each of the hardened slag cement blends was investigated for its physico-chemical and mechanical properties. In addition, identification of the phase composition of the formed hydrates by using X-ray diffraction (XRD) and differential thermal analysis (DTA) techniques. The results of the hardened slag cement pastes indicated that as the W/C ratio (initial porosity) increases the chemically combined water content (W_n , %) increases, the free lime content (CaO, %) increases, the free slag content decreases and the compressive strength values decrease. On the other hand, the results showed that as the applied

curing temperature increases the chemically combined water content (W_n , %) increases, the free lime content decreases and the free slag content decreases. Also, the pastes exposed to higher curing temperatures (45 and 60 °C) possess low ultimate compressive strength values at the later ages of hydration. From the results obtained, it can be concluded that the rate of hydration (hydraulic reactivity) of the granulated blast-furnace slag increases with the increase of W/C ratio (initial porosity) and with the increase of the applied curing temperature as well. Also, the results obtained from the feldspar-granulated blast-furnace slag system as slag coagulator in the smelting process indicated that the increasing of the blast-furnace slag content to 8 % (maximum) with decreasing the firing temperature to 1200 °C (minimum) and decreasing the average particle size to reach 1 mm (minimum) of slag coagulator increases the quantity of collected slag. Also, the increasing of the blast-furnace slag content with decreasing of the firing temperature of prepared mixes leads to decreasing in the density which helps in increasing quantity of collected slag.

Key words: Ordinary Portland cement
Granulated blast-furnace slag
Slag cement
Hydration
W/C ratio
Curing temperature
Feldspar
Slag coagulator
Smelting process

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