شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

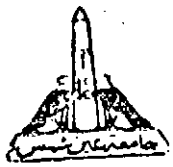
:حفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من 15-25 مئوية ورطوبة نسبية من 20-40%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم



PERFORMANCE OF BLAST FURNACE SLAG AND SULPHATE RESISTING CEMENTS IN SULPHATE SOLUTION

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Contents

1- Introduction and Objective

Blast furnace slag is a by-product obtained in the manufacture of pig-iron in the blast furnace. It is formed by the combination of iron ore and limestone flux.

Slag + iron produced by blast furnace + limestone flux ⟶ blast furnace slag.

In the operation of blast furnace the Fe_2O_3 is reduced by coke to metallic iron while SiO_2, Al_2O_3, CaO and MgO from molten slag float on the top of molten iron. The slag is obtained from the blast furnace as molten stream at a temperature of 1400-1500°C. Its conversion into products suitable for various uses depends on the subsequent processing used in cooling the molten slag. When the slag is allowed to cool slowly, a stable crystalline silicic rock product is formed with mechanical properties similar to basalt. This has been used for long time as road construction and is suitable as concrete aggregate. More rapid chilling with a limited amount of water produces a porous honeycombed materials. This lightweight material is called foamed slag and after crushing and grading is used as lightweight aggregate. The slag used in the manufacture of the various slag cements should be granulated and rapidly cooled.

Around thirty years ago , the granulation of the blast furnace slag was started in order to produce a granular bulk material out of the slag melt which can easily be transported, in doing so, a sand with a more or less high content of glassy constituents was formed which was found out to have certain hydraulic properties, the super cooled slag melt being the carrier of the latent hydraulic properties.

Thereupon, the granulation process was improved to obtain granulated blast furnace slag with a high glass content 90% for the production of slag cement. Many granulation processes were tested and applied. The aim of all the processes was to abstract as much heat as possible from a large quantity of molten slag in the shortest time possible. For that purpose the slag was broken into small droplets or grains up to a size of 3-5 mm, which were then brought into contact with a lot of air or water as coolants; Processes running with compressed air had the advantage of a dry product, and a glass content of only 60% to maximum 80% weight, were however obtained. Nowadays the granulation process is done using water cooling process. The slag is chilled very

rapidly either by pouring into a large amount of water or by subjecting the slag stream to jets of water or air and water. The purpose is to cool the slag so quickly that crystallization is prevented and solidifies as a glass. At the same time the quenching breaks up the materials into small particles. The ease with which a glassy phase is obtained depends on the chemical composition of the slag and the temperature at which it issues from the furnace. Siliceous slags are easier to form glasses compared to those of high lime content, the later however possesses a higher hydraulic activity in the presence of alkaline activator. The hydraulic value increases with CaO/SiO_2 ratio up to a limiting points, the CaO content should be around 40%.

In cement industry, slag is blended with portland cement in varying proportions producing what is known as portland blast furnace slag cements. In Egypt ES974 limits the slag content to 35%. BS146 allows slag content up to 65%, whereas BS4246 specified a slag content of 50 to 90 %. In USA where the cement is called portland blast furnace slag cement the granulated slag content is 25 to 65% (ASTMC595-68). In Germany two varieties are specified (DIN 1164) namely, Eisenportland cement containing not more than 40% and Hochofencement, from 41 to 85% granulated slag. In France, Ciment de Fer contains 25 to 35% granulated slag, Ciment Metallurgic Mixte,45 to 55%, Ciment de Haut fourne .65 to 75% and Ciment de Laitier au clinker at least 80%.

The portland blast furnace cement concrete are known for their low heat of hydration and should generally possess a high resistance to chloride diffusion and sulphate attack. The slag also reduces the reactivity of the cement with alkali reactive aggregates.

The purpose of this study is to characterize the Egyptian blast furnace slag used in the manufacture of local blast furnace slag cements. For this purpose the blast furnace slag obtained from Iron and Steel Company in Egypt was characterized in order to evaluate the suitability of its use in the cement manufacture compared to international standard specifications. Besides the behaviour of different laboratory made slag cements containing water and air cooled slag in water and sulphate solution were studied over a period of one year and compared with the behaviour of pure ordinary portland cement.

2- Literature Survey

In this study the literature is surveyed on the characteristics of the blast furnace slag, methods of slag granulation, and slag-cement system which individual item is described below.

2.1: Characteristics of Blast Furnace Slag :

Blast furnace was operated for producing pig iron low in Si and S by suppressing the activity of SiO_2 in hot zones and by adjusting slag viscosity. Powdered flux containing CaO and / or MgO is injected into tuyeres to control the basicity of slag at 1.22-1.30, and the Al_2O_3 content of the slag was adjusted to $\leq$ 17%[1].

A method for determining the glass content in inorganic waste was studied to aid in the prediction of the action of the waste on concrete. A quantitative X-ray diffraction method was used to compute the mass percentages of ∝-quartz, mullite magnetite, and hematite and the glass content by difference. The technique was improved in this study. Glass contents determined with this method ranged from 53.5 to 94.5%[2].

The viscosity and melting point of blast furnace slag containing TiO_2, CaO, SiO_2, Al_2O_3, and MgO were studied. An increase in basicity and TiO_2 and MgO content decreased the viscosity, but an increase in Al_2O_3 increased the viscosity slightly. The properties of the slag were affected mainly by their basicity[3].

The equilibrium phase composition of a blast furnace slag was studied by using the thermodynamic properties of the MgO-CaO-Al_2O_3-

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