MATEC Web of Conferences
Volume 120, 9 August 2017, Article number 03003
1st International Conference on Advances in Sustainable Construction Materials and Civil Engineering Systems, ASCMCES 2017; Al-Razi Hall, Medical and Health Science Colleges, University of SharjahSharjah; United Arab Emirates; 18 April 2017 through 20 April 2017; Code 129693

Performing self-compacting concrete with electric arc-furnace slag as aggregates (Conference Paper)

Santamaría, A.[a], San-José, J.T.[a], Vegas, I.[b], Ortega-López, V.[c], Jesús González, J.[a]

[a]UPV/EHU, Dept. of Engineering Materials, Alameda Urquijo, s/n, Bilbao, Spain
[b]TECNALIA. C/Geldo, Parque Tecnológico de Bizkaia, Edificio 700, Derio, Spain
[c]University of Burgos, EPS, Dept. of Civil Engineering, C/Villadiego s/n, Burgos, Spain

Abstract

View references (16)

The electric steelmaking industry is of great importance to the economy of the Basque Country (Spain). In all, 600,000 tons of electric arc-furnace (EAF) slag are produced every year; a by-product that this research group believes can be transformed into a useful resource. One of the uses of this material is as an aggregate in hydraulic mixes. Many studies have demonstrated that hydraulic mixes manufactured with EAF slag have at least the same mechanical behaviour and durability as ordinary concrete. However, their weaknesses are their higher density and poorer workability. In this paper, the aim is to demonstrate that manufacturing slag concrete to an acknowledged standard of workability is possible; so the objective is to manufacture self-compacting concrete using EAF slag in partial substitution of aggregates. Our analysis of the successful manufacture of three different self-compacting mixes, their properties in the fresh state and their mechanical behaviour yielded very encouraging results. © The Authors, published by EDP Sciences, 2017.

Indexed keywords

Engineering controlled terms: Aggregates, Concrete aggregates, Concretes, Electric arcs, Electric furnace process, Electric furnaces, Furnaces, Manufacture, Mechanical properties, Slags, Steelmaking furnaces, Sustainable development

Electric arc furnace
Electric arc furnace slags
Electric steel making
Mechanical behaviour
Ordinary concretes
Partial substitution
Research groups
Self-compacting

Engineering main heading: Self compacting concrete

ISSN: 2261236X
Source Type: Conference Proceeding
Original language: English

DOI: 10.1051/matecconf/201712003003
Document Type: Conference Paper
Volume Editors: Barakat S.,Maalej M.,Al-Ruzouq R.,Hamad K.,Shanableh A.,Al-Toubat S.,Omar M.
Sponsors: American Concrete Institute,et al.,International Society for Photogrammetry and Remote Sensing,Sharjah Electricity and Water

As it has been stated in the previous section the concrete that reaches the higher compression strength value was the one manufacture with EAF slag and manufactured with Cement I. It has enhanced strength 32% higher than the natural aggregate concrete. As stated in a previous work [16] from this research group, the ITZ between EAF slag aggregates and the cement matrix will often be of better quality than the ITZ of natural aggregates and cement matrix with a consequent increase in its macroscopic compressive strength.

These values are encouraging taking into account that cement Type IV/B 32.5 N, according EN-1015, containing a high proportion of fly ash (see Table 2) was used to manufacture this mix rather than cement I 52.5 R that was used in the manufacture of the other mixes.

A full analysis of all the data confirms the successful manufacture of a self-compacting structural concrete containing EAF slag in partial substitution of conventional aggregate in terms of its mechanical strength.

6 Conclusions

The conclusions of this study are as follows:

- Manufacturing self-compacting concrete with electric arc furnace slag as aggregate is feasible.
- A suitable increase of the fine aggregate fraction is advisable when EAF slag is used.
- Finding a compatible admixture is essential, as not all admixtures will work appropriately with the EAF slag aggregate;.
- The mechanical strength tests on these concretes showed encouraging results.
- In the absence of performing durability tests, it could be said that well-performed self-compacting concrete with EAF as aggregate have been manufactured.

Our thanks to the Basque Regional Government (IT781-13 Research Group), to the Vice-Rectorate of Investigation of the University of the Basque Country (UPV/EHU) for grant PIF 2013, to the FEDER program, and to the Spanish Ministry (MINECO) (project BIA2014-55576-C2-2-R), for funding this research work. Materials were supplied by Hormor-Zestoa, Arcelor Mittal and CHRYSO Admixtures.

References

1. *Steel Statistical Year book*. International iron and steel institute (2005)
2. *Steel Statistical Year book*. International iron and steel institute (2015)
3. M. Pasetto, N. Baldo, Mix design and performance analysis of asphalt concretes with electric arc furnace slag, Construction and Building Materials **25**(8), p 3458-68 (2011).
4. F. Faleschini, M. A. Fernández-Ruiz, M.A. Zanini, K. Brunelli, C. Pellegrino, E. Hernández-Montes, High performance concrete with electric arc furnace slag as aggregate: Mechanical and durability properties, Construction and Building Materials **101** 113-121 (2015).
5. K. Morino, E. Iwatsuki, Utilization of electric arc furnace oxidizing slag as concrete aggregate, Minerals, Metals and Materials Society/AIME, REWAS'99: *Global Symposium on Recycling, Waste Treatment and Clean Technology*. pp. 521-30 (1999).
6. I. Papayianni, E. Anastasiou, Concrete incorporating high-calcium fly ash and EAF slag aggregates, Magazine of Concrete Research **63**(8) 597-604 (2011).
7. J.M. Manso, J.J. Gonzalez, J.A. Polanco, Electric arc furnace slag in concrete, Journal of materials in civil engineering **16**(6) 639-645 (2004).
8. J.T. San-José, I. Vegas, I. Arribas, I. Marcos, The performance of steel-making slag concretes in the hardened state, Materials & Design **60** 612-619 (2014).