materials proceedings

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Abstract

Effect of Portland Cement Addition in Ferrosilicon Slag Alkali Activated Materials †

P. Delgado-Plana [1,*], S. Bueno-Rodríguez [1,2], L. Pérez-Villarejo [2,3] and D. Eliche-Quesada [1,2]

[1] Department of Chemical, Environmental, and Materials Engineering, Higher Polytechnic School of Jaén, University of Jaen, Campus Las Lagunillas s/n, 23071 Jaén, Spain; jsbueno@ujaen.es (S.B.-R.); deliche@ujaen.es (D.E.-Q.)
[2] Center for Advanced Studies in Earth Sciences, Energy and Environment (CEACTEMA), University of Jaén, Campus Las Lagunillas s/n, 23071 Jaén, Spain; lperezvi@ujaen.es
[3] Department of Chemical, Environmental, and Materials Engineering, Higher Polytechnic School of Linares, University of Jaén, Campus Científico-Tecnológico, Cinturón Sur s/n, 23700 Linares, Spain
* Correspondence: pdplana@ujaen.es
† Presented at the Materiais 2022, Marinha Grande, Portugal, 10–13 April 2022.

Keywords: ferrosilicon slag; alkali activated material; mechanical properties; circular economy

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Citation: Delgado-Plana, P.; Bueno-Rodríguez, S.; Pérez-Villarejo, L.; Eliche-Quesada, D. Effect of Portland Cement Addition in Ferrosilicon Slag Alkali Activated Materials. *Mater. Proc.* **2022**, *8*, 122. https://doi.org/10.3390/materproc2022008122

Academic Editors: Geoffrey Mitchell, Nuno Alves, Carla Moura and Joana Coutinho

Published: 11 July 2022

Ferrosilicon is produced by smelting quartzites in closed submerged electric arc furnaces (22 to 93 MVA). The slag obtained is heterogenous, containing relatively high percentages of aluminosilicates [1]. Typically, these concentrations are in the range of 48–50 wt% SiO_2 and 20–25 wt% Al_2O_3, but not necessarily. In this research, alkali activated materials were developed from this residue by adding different percentages of Portland cement to achieve the best mechanical properties.

Samples were prepared by mixing the solid material with an alkali activating solution and pouring the mix into molds of $60 \times 10 \times 10$ mm^3. An alkali solution was made using NaOH pellets Panreac (98% purity). First, control samples made exclusively with ferrosilicon slag were manufactured. The compressive strength of the control samples was 7.9 and 14.0 MPa at the age of 7 and 28 days, respectively.

After that, the technical viability of the partial substitution of the ferrosilicon slag with ordinary Portland cement was studied in percentages of 10, 20, and 30 percent. In this case, the highest compressive strength was obtained in samples with a larger amount of Portland cement, which reached values of 18.5–24.7 MPa at the ages of the test (7–28 days).

The outcome of this research suggests that ferrosilicon slag might be a useful raw material in the manufacture of alkali activated materials. Therefore, this preliminary study confirms the use of these by-products or industrial waste for the manufacture of alkali activated materials to bring us closer to a circular economy. In addition, the mixture with Portland cement leads to an additional improvement in technological properties, at least in percentages from 10 to 30 wt%.

Author Contributions: Conceptualization, P.D.-P. and D.E.-Q.; methodology, P.D.-P. and D.E.-Q.; validation, P.D.-P. and D.E.-Q.; formal analysis, P.D.-P.; investigation, P.D.-P.; resources, D.E.-Q.; data curation, P.D.-P.; writing—original draft preparation, P.D.-P.; writing—review and editing, P.D.-P., S.B.-R., L.P.-V. and D.E.-Q.: visualization, P.D.-P.; supervision, D.E.-Q., L.P.-V. and S.B.-R.; project administration, D.E.-Q.; funding acquisition, D.E.-Q. All authors have read and agreed to the published version of the manuscript.

Funding: This work has been funded by the project GEOCIRCULA: Economía circular en la fabricación de nuevos composites geopoliméricos: hacia el objetivo de cero residuos (P1 8-RT-3504) Consejería de Economía, Conocimiento, Empresas y Universidad. Secretaría General de Universidades, Investigación y Tecnología/FEDER "Una manera de hacer Europa".

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgments: The authors thank the "Ferroatlántica" company for supplying the ferrosilicon slag waste. The technical and human support provided by the CICT of Universidad de Jaén (UJA, MINECO, Junta de Andalucía, FEDER) is gratefully acknowledged.

Conflicts of Interest: The authors declare no conflict of interest.

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