Effect of addition of spent oil filtering earths on electric arc furnace slag alkaline activated cements

P. Delgado-Plana[1,2*], P.L. Quesada-Lirio[1], S. Bueno-Rodríguez[1,2], P. J. Sánchez-Soto[3],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
[2]Center for Advanced Studies in Earth Sciences, Energy and Environment (CEACTEMA), University of Jaén, Campus Las Lagunillas, s/n, 23071 Jaén, Spain
[3] Institute of Materials Science of Sevilla, Joint Center of CSIC (Spanish National Research Council) and University of Sevilla, 41092-Sevilla, Spain

INTRODUCTION

GEOPOLYMERS OR ALKALI ACTIVATED MATERIALS

20-50 % CO_2 emissions reduction
No high temperatures in manufacturing
Good thermal and mechanical properties

PORTLAND CEMENT

Produced under high temperatures
Responsible for 6-8 % of global CO_2 emissions.

SOME INDUSTRY WASTES DATA

Black slag is produced at a ratio of 110-140 kg per ton of steel
1,861,000 Tons of black slag generation in Spain per year (2018)
Spent oil filtering earths (SOFE) are oily and moist waste from oil industry, not easily disposable.

RAW MATERIAL CONDITIONING AND SAMPLES MANUFACTURE

ELECTRIC ARC FURNACE SLAG (EAFS)

1. Drying at 105 ºC
2. Ground in ball mill
3. Sieving (<0.100 mm)

SPENT OIL FILTERING EARTHS FROM INDUSTRY (SOFE)

1. Drying at 105 ºC
2. Calcination 2h - 700 ºc
3. Ground in ball mill
4. Sieving (<0.100 mm)

SYNTHESIS OF THE SAMPLES TO TEST

SAMPLE DESIGN

PRECURSOR:
EAFS + SOFE
(0, 10, 20, 30, 40, 50 weight percentage)

+

ALKALI SOLUTION:
NaOH 8 M
+
Commercial Na_2SiO_3
(Ratio 1:1)

GEOPOLYMER MANUFACTURE

Precursor addition and planetary mixer homogenization (120 s)

Pouring into moulds (10 x 10 x 60 mm)

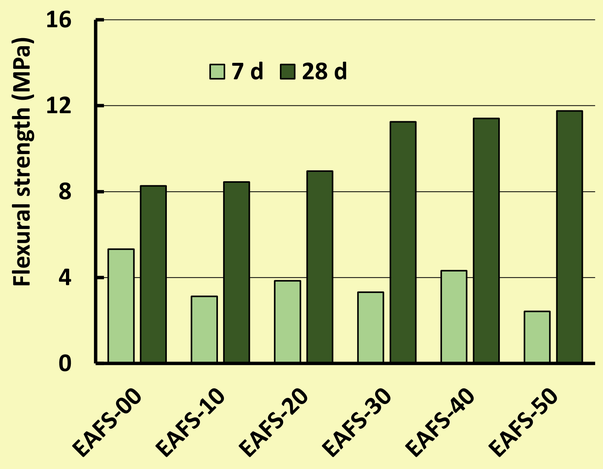
60 strokes on Proeti punching table

RESULTS AND DISCUSSION

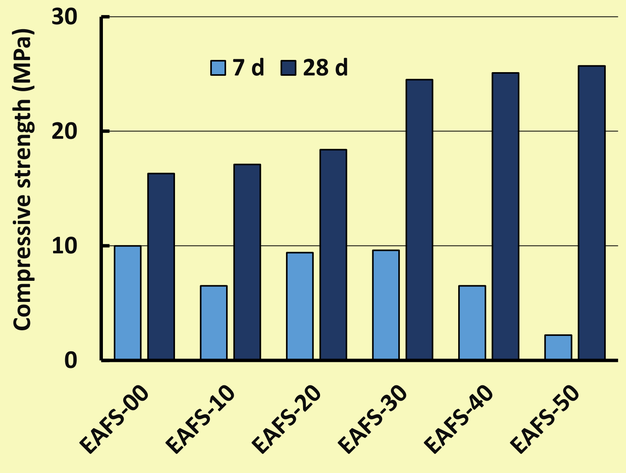
MECHANICAL TEST

Mechanical test were carried out to determine the performance of the prototypes as structural materials at 7 and 28 days.
Spent filtering earths addition led to higher strength, but only at 28 days owing to the slower geopolymerization reaction of this raw material in comparison with EAFS.

Flexural strength test



Compressive strength test



CONCLUSIONS

Experimental investigation revealed that the addition of SOFE increases flexural and compressive strength at 28 days from 8.3 up to 11.8 MPa and from 16.3 up to 25.7, respectively. The combination of both residues showed to be advantageous in terms of wastes recycling and mechanical properties development. In this sense, EAFS and SOFE are interesting residues that can be used as adequate precursor for alkali activated materials or geopolymers in the line of current policies for circular economy and sustainable development goals (SDG's).

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